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A EUROPEAN ANT (MYRMICA LEVINODIS) INTRODUCED INTO MASSACHUSETTS

It is surprising that very few ants have been introduced into North America from Europe, notwithstanding the great facilities for transportation between the two countries, the similarity of their climatic and physiographic conditions and the close affinities of their ant-faunas. One species only, *Tetramorium cespitum*, has been recorded as of European provenience, and this, though of many years' residence among us, is still confined to the Atlantic States (Connecticut to Maryland). I have recently come upon a second ant which must have been introduced into Massachusetts. Early in September I found a large colony of *Myrmica levinodis* Nylander in the grass at the edge of the Arnold Arboretum, a few steps from the Bussey Institution, at Forest Hills, Mass. The workers were attending plant-lice (*Aphis* sp. near *rumicis*) on a few stalks of *Chenopodium album* very near their nest. Some days later a second colony was discovered at the edge of Franklin Park, about a mile from the Arboretum. Early in October a third colony was seen on a lawn near the postoffice in Jamaica Plain. Though by no means common, it is certain that this ant has begun to spread over the country about Forest Hills.

M. levinodis was formerly regarded as one of a number of subspecies of a single circumpolar species, *Myrmica rubra* L. Emery[1] has recently raised the subspecies *scabrinodis, sulcinodis,* etc., to specific rank, but has retained *levinodis* and *ruginodis* as subspecies of *rubra.* It is clear, as he remarks, that Linné must have described one or both of these forms as *rubra,* since he introduced into his diagnosis the

[1]Beiträge zur Monographie der Formiciden des paläarktischen Faunengebiets. Deutsch. Ent. Zeitschr., 1908, pp. 165–182.

words "*pessime nostratum pungit,*" and it is now known that none of the other European or North American forms of *Myrmica* (except *rubida* and *mutica,* which form a group by themselves) has well-developed stinging powers. As there are no means of telling to which of the two forms Linné referred, and as they are connected by numerous intermediate varieties, known to European myrmecologists as *levinodis-ruginodis,* we had best adopt Emery's interpretation.

A few years ago I described[1] a form of *levinodis* from Woods Hole, Mass., as var. *bruesi.* On comparing workers of this and of the *levinodis* from Boston with workers from a number of colonies from various parts of Europe (Scotland, England, Norway, Sweden, Germany, Austria, Switzerland and Russia), I find that the Boston specimens are indistinguishable from the typical Old World form. They are yellowish, with brownish head, feebly sculptured head and thorax, and with smooth and shining epinotal declivity and postpetiole. These characters will serve to distinguish *levinodis* from any of our American Myrmicas. The workers of the var. *bruesi* have the head and thorax somewhat more coarsely rugose, and the postpetiole, though smooth, is subopaque, so that this variety is more like some of the European intermediates between *levinodis* and *ruginodis.* The males of *bruesi,* however, have prominent, suberect hairs on the legs, like the males of the true *levinodis.*

I believe there can be no doubt that both the Boston and Woods Hole specimens are the offspring of females that were accidentally imported from Europe. The mothers of the Boston colonies were in all probability introduced into the Arnold Arboretum with European trees or shrubs, and as the few colonies observed by Mr. C. T. Brues and myself at Woods Hole occupied a very circumscribed locality adjoining Mr. Fay's rose-garden, they probably had a similar history.

[2]Forel has described two subspecies of *rubra* from North America as *neolevinodis* and *champlaini,* and if these be regarded as indigenous to the country, it is clear that the Massachusetts colonies of *levinodis* and *bruesi* might be similarly interpreted. The Swiss myrmecologist states that *M. neolevinodis* was introduced into Hamburg "from New York with iris roots." The worker is described as having thicker and shorter antennæ than the typical *levinodis,* with more decidedly bent scapes, a shorter petiole, with nearly straight anterior declivity and somewhat coarser cephalic and thoracic sculpture. As I have never been able to find any form of *levinodis* in New York state, and as the

[1]New Ants from New England. Psyche, XIII, 1906, pp. 38–41, pl. IV.

[2]Formiciden des naturhistorischen Museums zu Hamburg. Mittheil. aus d. naturhist. Mus. Hamb. XVIII, 1901, pp. 45–82.

iris roots in which Forel's form were found may have reached Hamburg from Japan or Siberia by way of New York, I am not convinced that *neolevinodis* is an American insect. *M. champlaini* was taken by Forel himself in a meadow near Quebec. The worker of this subspecies is described as being very similar to that of *neolevinodis,* but as having teeth instead of spines on the epinotum. The sculpture of the head and thorax is coarser than in the European *ruginodis,* the petiole and postpetiole are smooth except for a few lateral furrows, and the antennæ are as short as those of *neolevinodis* or even shorter. As Quebec has long been in direct and intimate communication with Europe, it is not at all improbable that *M. champlaini* is merely a rather pronounced imported variety of *levinodis.* Finally, I may state that although I have brought together a very large collection of Myrmicas from all parts of temperate North America, I have never been able to find any forms allied to *levinodis* except the two mentioned above. I am therefore of the opinion that the true *M. rubra,* as recently defined by Emery, is not indigenous to North America.

The preceding remarks have merely a theoretical bearing, but the introduction of *M. levinodis* into the United States may have some economic importance, for this ant is the most disagreeable of the palearctic Myrmicas. It forms much more populous colonies than *scabrinodis, sulcinodis, brevinodis* and their numerous varieties, and its workers are aggressive and sting severely.

It is very fond of attending aphids and, unlike our timid native Myrmicas which live in the retirement of woods, bogs, heaths and waste places generally, it prefers to nest in cultivated soil. Hence it may become a nuisance in lawns and dooryards, like the fire-ant (*Solenopsis geminata*) of the Southern States. It is, of course, impossible to ascertain how long the typical *levinodis* and its variety *bruesi* have been living in Massachusetts, or whether their spread will be checked by any of our native ants. The aggressive character of the imported forms would seem to indicate that they will meet with little or no opposition from the allied indigenous species, and as *levinodis* flourishes in Norway and the Alps, it will hardly find our severe winters a serious obstacle to the growth and multiplication of its colonies. It may be advisable, therefore, to keep this belligerent immigrant under observation.

W. M. Wheeler.

Bussey Institution,
Forest Hills, Boston, Mass.,
October 1, 1908.

WASP STORING KATYKIDS IN A WELL

By E. S. Tucker, *Bureau of Entomology, U. S. Dept. of Agric.*

Two years ago in August a correspondent at Osage City, Kansas, sent me some specimens of a narrow-winged katydid, which were identified as *Scudderia curvicauda* De G., and in his letter he stated that they had been drawn up in a bucket of water from a well 30 to 35 feet deep, where the insects were floating. A few days before these bodies were taken he had observed a large black wasp in the act of carrying one of the same kind of katydids into the well and saw the wasp drag its prey into a cranny of the rocks, about a yard below the surface of the ground. No definite description of the wasp was given further than that it was over an inch long and "slender-waisted." One or two torpid katydids were seen lying on the very edge of rocks in the wall near the spot where the above example had been stored away, from which position any of the bodies might easily slip and fall off into the water below. The number of bodies floating in the well had been increasing during the week until twenty or thirty were visible. In the meantime some of them, probably a dozen specimens, had been drawn up in buckets of water and thrown away. One of these specimens evinced faint indications of life by movements of its mouthparts.

The question was asked if these bodies showed signs of having been stung and if eggs had been laid upon them by the wasp. To prove that the bodies were stung, the act of stinging must be witnessed, and since the specimens had become partly macerated, no evidence of eggs could be detected, though there remained no doubt, judging from the habits of rapacious wasps, but that the katydids had been stung when captured, and the wasp's intent upon storing them would naturally be for the purpose of depositing an egg in a safe place with each body.

Having concluded that the wasp had appropriated the well as her rightful property, the correspondent wanted to know if she intended to stock the crannies of the wall with paralyzed katydids so that her progeny when hatched from the eggs laid with these stored bodies could be reared upon them. In such a case, he asked if a host of wasps would likely hatch out soon as perfect insects. A brief explanation of the life history of robber-wasps was given in reply. However, as the matter stood, the bodies of katydids which fell into the water became decomposed and rendered the water objectionable for use on account of danger of pollution. According to the owner's statement, this trouble had never happened before to his knowledge, at least within fifteen years. He had already considered the advisabil-

ity of cleaning out the bodies of the insects in order to keep the water pure. The wasp, of course, should be caught and killed to prevent further introduction of bodies into the well.

My desire to obtain the specimen if possible and know definitely what kind of wasp was doing the work led to further correspondence, which brought the information that unsuccessful attempts had been made to capture a specimen because the insect was exceedingly wary, although two wasps then frequented the well. They were mentioned as being the largest black kind of solitary digger-wasp common to the country. They flew very swiftly and were seen to alight only when they entered the well. Shortly after the receipt of this communication the correspondent visited me and pointed out in a collection of insects the wasp known as *Proterosphex pennsylvanica* L., which he positively declared was the kind that came to the well.

NOTES ON ASPIDIOTUS DESTRUCTOR (SIG.) AND ITS CHALCID PARASITE IN TAHITI

By R. W. Doane, *Stanford University*

For many years the Transparent Cocoanut Scale, *A. destructor* Sig., has been an important enemy of the cocoanut and other palms in many parts of the tropics. During the last few years it has been doing particular damage to the cocoanut trees in the Society Islands. On some of these islands many of the trees have been killed and others so badly affected that they bear no nuts. On some of the coral islands the conditions are still so bad that practically no crop is gathered. On Tahiti and some of the more important of the other islands, plantations that a few years ago were yielding no nuts are now in full bearing again and the trees are looking fine and thrifty. In the interests of one of the planters I visited these islands last summer to study the conditions that controlled the appearance and disappearance of this pest. None of the planters has any idea of when the insect was introduced there, but few of them, in fact, realize that it is an insect that is causing the so-called "blight" on their trees. But as it is now common on practically all of the South Sea islands it probably found its way into the Society Islands very early, as Tahiti is a central point, from which ships come and go to all south Pacific ports. A few years ago it must have begun increasing very rapidly. I was told that in Tahiti the "blight" was so bad and spread so rapidly from one part to another that it seemed that all the trees would be destroyed. At one time so many of the plantations were affected, par-

ticularly on the leeward side of the island, that it was even difficult to get cocoanuts to drink, and of course no copra was exported.

The insect attacks all parts of the tree, except the roots and old trunk, in all stages of its growth. The first few leaves of the young plant are often completely covered on the underside with the scales, causing them to turn a characteristic yellow color and usually killing the young plant, unless relief comes. On the older trees all parts of the leaves may be infested, the flower-spike is usually well covered and the husk of the nut is often so completely covered that it would seem impossible for another insect to find lodgement.

On some parts of the island I found many of the trees thus covered, some of the younger ones dying, the older ones having no nuts, but on most of the plantations the scale seems to be disappearing at a very rapid rate. Trees that three years ago bore no fruit are now in fine foliage and bearing their full quota of nuts. The planters say that this change was brought about by different weather conditions, but my studies there show that the primary cause of this sudden change was the introduction and development of the chalcid parasite *Aspidiotiphagus citrinus* Craw (identification kindly confirmed by Doctor Howard). Whether the parasite was introduced with the scale and did not find conditions favorable for its development until the scales were very abundant or whether it was introduced later, we could not tell, but it is there in immense numbers now. On some trees 50 to 75 per cent of the scales were parasitized and on many others practically all the scales were dead, but I could not find indications of the parasites' work on all of them. As the parasite may sometimes escape between the upper and lower scales instead of making the characteristic round hole in the upper scale, it is not always easy to tell by simply examining the scale whether the insect has been killed by the parasite or not. Many of the dead insects under scales that show no signs of the parasite having issued will exhibit unmistakable signs of its work when they are examined with the microscope. On a badly infested leaf I have seen as many as ten adult parasites within a radius of 3 or 4 inches walking about over the scales, stopping now and then on one, presumably to deposit an egg.

I have seen specimens of this scale more or less badly parasitized from Tahiti, Morea, Titioroa, Raiatea, Tahaa Huaheine and Flint Island. As the parasite is already so well distributed the only recommendation made to the planters was that they introduce it into groves where it does not seem to be present or occurs as yet in small numbers. I believe that, under normal conditions, the parasite will soon have this scale so well under control that it will no longer be a menace to the trees.

WORK OF THE BUREAU OF ENTOMOLOGY AGAINST FOREST INSECTS

By A. D. Hopkins, *Washington, D. C.*

Historical

Prior to 1902 the work in the United States on insects affecting forest trees consisted of local observations by state and government entomologists in connection with general studies of insects in their relation to agriculture, but no one, up to that time, had given special attention to the investigation of the forest insects of the entire country and very little was then known of the principal insect enemies or the character and extent of their depredations.

Under the act establishing the Entomological Commission of the Department of the Interior, and under subsequent acts to March 3, 1881, two publications were issued, one of 275 pages on insects injurious to forests and shade trees, issued as Bulletin 7 of the Department of the Interior in 1861; the other, an enlarged and extended edition of the first, entitled "The Fifth Report of the Entomological Commission," containing 855 pages and issued by the Department of Agriculture in 1890 (under joint resolution, Congressional Record, July 7, 1882). These publications comprised a compilation of practically all of the available literature on the subject up to the date of submittal, in 1887, but included little of practical value on the control of the insect enemies of the forest proper.

In 1891 the investigation of forest insects was inaugurated as a special entomological feature of the work of the West Virginia Agricultural Experiment Station, and was continued until July 1, 1902. In the meantime the Division (now Bureau) of Entomology employed the entomologist of the West Virginia Station to conduct special investigations in California, Oregon, Washington and Idaho in the spring of 1899; in Maine in the spring of 1900; in New York in 1901; and in the Black Hills of South Dakota in the fall of 1901 and spring of 1902. Up to July 1, 1902, the West Virginia station had issued 49 publications of 855 pages, with 16 plates and 236 figures, and the Division of Entomology 3 publications of 99 pages with 23 plates and 10 text figures, based on the results of original investigations of forest insects.

On July 1, 1902, the office of Forest Insect Investigations was established under the general appropriation for entomological investigations, as one of the special branches of the work of the Division of Entomology. The objects, as set forth in the general project, were to

conduct original investigations in the forest and laboratory to determine (1) the principal insect enemies of forests and forest products; (2) the character and extent of the problems which, on account of the losses involved, demand special attention; and (3) the more important facts in the life and habits of the destructive insects, local forest management, lumbering operations, beneficial insects and other natural influences upon which to base conclusions and recommendations relating to practical methods of preventing losses.

Up to the present time investigations have been conducted in all of the principal forest regions of the country. The subjects which have received special attention are indicated by the titles of the following projects:

1. Insects of the Black Hills Forest.
2. Insects of the Southern Forests.
2a. Relation of Sulphur Dioxid in Smoke to Injuries by Insects to Forest Trees.
3. Insects of the Middle and Eastern Forests.
4. Insects of the Northwestern and Pacific Coast Forests.
5. Insects of the Southwestern Forests.
6. Insects of the Northern Section of the Rocky Mountain Forests.
7. Explorations and General Study of Forest Insects in the U. S.
8. Forest Reproduction Insects.
9. Relation of Environment to Injury to Forest Trees by Insects.
10. Interrelation of Insects and Forest Fires in the Destruction of Forests.
11. Insect Injuries to Forest Products.
12. Bark Weevils of the Genus Pissodes of North America.
13. Hickory Insects.
14. Ash insects.
15. The Scolytid Bark and Timber Beetles of North America.
16. The Buprestid, or Flat-Headed, Bark-and-Wood-Borers of the United States.
17. The Cerambycid, or Round-Headed, Wood-Borers of the United States.
18. Beneficial Forest Insects.
19. Black Locust Insects.
20. Trap Tree Experiments of Biltmore Estate, N. C.
21. Investigations of Damage by Wood-Boring Insects to Deadened and Felled Cyprus Timber in the Southern United States.
22. Breeding Insect-Resisting Black Locust.
23. Larch Sawfly in Northern Michigan.
24. Relation of Storm-Felled Timber in Mississippi to Depreda-

tions by Barkbeetles, and General Study of the Forest Insect Fauna of Western Texas and Southern New Mexico.

25. Investigations in the National Forests.

26. Inspections and Estimates of Insect-Killed Timber in the National Forests of Colorado.

27. Injuries by Bark- and Wood-Boring Insects to Trees Defoliated by the Gypsy Moth and Browntail Moth.

28. Diseases of the Larch Sawfly.

29. The Fauna and Flora of a Larch Swamp at Cranesville, W. Va.

30. Breeding Insect-Resistant Forest Trees.

31. Practical Application of Results of Forest Insect Investigations —Forest Insect Control as Applied to Private Interests.

32. Insect Control of the National Forests—Coöperative project, Bureau of Entomology and Forest Service.

33. Systematic and Economic Investigations of the Bark Lice of the Genus Chermes.

Work on a number of these projects has been completed, and full reports and recommendations published, as well as expert information and advice given out in correspondence. Encouraging progress is being made on the remainder, some of which it will take many years to complete.

Results

Satisfactory progress has been made towards the attainment of some of the fundamental objects of the investigations, one of which has been the laying of a substantial foundation for forest entomology in this country, on which future progress can be made along the lines of acquiring, disseminating, and applying information of immediate practical value in the protection of our forest resources. The principal results of the past six years' work which have contributed to this end may be summarized as follows:

Acquired New Information

(1) The principal insect enemies of the forest and forest products of North America, and the general character and extent of their depredations have been determined;

(2) Evidence has been accumulated which indicates quite clearly that insects are now causing a greater average annual loss of matured timber and forest products in the United States than that resulting to the same class of resources from forest fires. It has been determined that many extensive denuded areas of the Rocky Mountain region, supposed to have been caused by fire, were primarily due to

widespread depredations by insects on the living timber previous to the fire. In fact, the results of the investigations have clearly shown that in the future successful management of American forests the insect problem must rank with the fire problem, as well as with many other problems which heretofore have received far greater attention by expert foresters and the public.

(3) Many of the problems which, on account of the losses involved, demand special investigation, have been located, and much information of practical value relating to them has been acquired.

(4) The more important facts in the life history, habits, and practical methods of control relating to some of the more destructive insects have been determined.

(5) It has been demonstrated that some of the most destructive enemies of American forests can be controlled with little or no cost over that involved in ordinary forest management and business methods if the expert information now available is properly utilized.

(6) A mass of original data has been collected relating to forest insects in general, including not only those which are destructive or injurious, but those which are beneficial or neutral in their relation to the forest, and represented by a collection of more than a million specimens of insects and their work.

(7) The accumulated evidence clearly indicates that the insect damage to forest growth and manufactured commercial and utilized forest products of the United States represents losses aggregating more than $100,000,000 annually.

(8) As a direct result of the investigation of forest insects (conducted by this Bureau) during the past six years, at a cost of less than $53,000, there has been accumulated a reserve fund of information now available through publications, correspondence, and field demonstrations, which, if properly utilized for practical application, will evidently prevent a large per cent of the annual losses at a very small cost.

Practical Application

The increasing interest in the subject of preventing losses from depredations by forest insects manifested by owners of forests and farmers' wood lots, and by manufacturers and consumers of forest products throughout the country, also by the Forest Service in its efforts towards the control of extensive depredations in the National Forests, indicates that there is a quite general practical application of some of the disseminated information and that there is an increasing tendency to rely on expert advice as a guide to securing the best results.

Some of the results of the practical application of information based on entomological investigations which have been reported or observed may be mentioned as follows:

The control of the eastern spruce beetle in northeastern Maine and the saving of $100,000 to one firm; the complete control of the hickory bark beetle on Belle Isle Park, Detroit, Michigan, where the total destruction of one of the attractive and valuable features of the Island was threatened.

The complete control of an alarming outbreak of the Black Hills beetle in the vicinity of Colorado Springs and Palmer Lake, Colorado, and the adjoining National Forests, thus protecting the pine timber, which is one of the valuable and attractive features of the region, representing a cash value of several million dollars.

The complete control of the same insect, which was threatening the destruction of the pine timber on an extensive estate in the vicinity of Garland, Colorado, which would have resulted in a loss of timber and reduced value to the state of perhaps more than a million dollars.

Our recommendations for the control of powder post insects have been adopted by many of the leading manufacturers of seasoned hardwood products and by dealers and consumers of the same, and it is evident that it has resulted in the saving of many millions of dollars' worth of property.

The real value, however, of these examples of successful control is far greater than that represented by the amount of property protected, since they have served to demonstrate:

That some of the most destructive and dangerous enemies of the eastern and western forests can be controlled at slight or no expense whenever the infested timber can be utilized within a given period after it is attacked;

That manufacturing and business methods can be so adjusted that without additional expense a very large per cent, and in many cases all, of the great losses from powder post injury can be avoided;

That by the adoption of improved methods of forest management and the proper adjustment of certain details in such management to meet the requirements for prevention of insect depredations, a large per cent of the losses may be avoided without additional expense;

That, as a rule, it is useless and undesirable to attempt the extermination of an insect enemy of the forest. It is only necessary to reduce and weaken its forces so that it cannot continue an aggressive invasion but must occupy a defensive position against its own enemies and become dependent upon favorable conditions resulting from the

negligence and mismanagement of the owners of the forests and the manufacturers of forest products;

The absolute necessity of expert entomological advice as a guide to doing the proper thing at the proper time and at the least expense to secure the best results.

CYANIDE AS AN INSECTICIDE

By R. S. Woglum, *U. S. Bureau of Entomology,* and
William Wood, *Los Angeles Horticultural Commission*

Cyanide of potassium has been used for many years as one of the ingredient chemicals for obtaining hydrocyanic acid gas, the most powerful and successful of gaseous insecticides. The writers are not aware of cyanide of potassium having been previously suggested in literature as an insecticide in itself. From experimentation we have found it most efficient in the destruction of a common form of red ant.

In the rear yard of the California Citrus Substation, of the United States Bureau of Entomology, at Whittier, is a spot of hard-packed bare ground about 20 by 30 feet. This ground contained several scores of exit burrows of a common red ant. During the cooler part of the day ants were so numerous on this spot that it was impossible for a person to walk here without stepping on as many as fifty at every move. The insect became such a nuisance that steps were taken for its control. Carbon bisulphide was first tried, but the expense of the material made it prohibitive for so many burrows. Later a spray of cyanide of potassium, one half of an ounce to a gallon of water was used on part of this ground and resulted in destroying almost all ants running about on the part sprayed. This solution, although successful, acted so slowly that it was decided to double its strength. The next evening when the ground was seemingly alive with ants the entire spot was thoroughly sprayed with a solution of one ounce to the gallon of water. This not only very quickly destroyed all ants on the ground, but also such as emerged from the burrows several minutes afterward were overcome by the fumes which were given off from the damp ground. The following day less than a quarter as many ants were moving over the ground as previously. The dead ants had been collected into heaps at different places by those which remained alive.

No farther efforts to exterminate were made for two weeks, at the end of which the ants had become almost as numerous as ever. Then a pit large enough to hold a quart of solution was hollowed out at the

exit of each burrow and filled with the poison. The whole ground was gone over in this manner. An examination was made the next day and resulted in finding less than twenty-five live ants on all the ground treated. In and around some of the pits were heaps of dead ants which apparently had been carried out by such members of the colony as escaped destruction. A second treatment of these colonies usually reached what still remained alive. Where no dead ants had been brought out, probably the entire colony was destroyed. One of these burrows was opened up with the result of finding pockets filled with dead ants as much as one and one half feet below the surface. A few days after using this insecticide the pits were refilled and the ground leveled. Ten days later an examination showed about a dozen fresh burrows of apparently very weak colonies. A second yard was treated after the same manner with almost complete eradication.

Our success with this cyanide solution in almost freeing ground of ants by the use of one, or a partial second, application leads us to believe that under favorable conditions ants (at least some species) can be entirely eradicated from a piece of ground by repeated applications. The poisonous gas from this solution must penetrate deep into the ground. A strong odor of the gas was evident in a burrow opened up two days after the solution was applied. It is entirely possible that this solution will prove of some value against the ground colonies of the Argentine ant.

The success obtained against the ground form of ants suggested that the insecticide might be put to some use against various ground forms of insects as woolly-aphis, thrips, etc. To determine this point it was first necessary to learn if the solution was injurious to plant life. Two gallons were poured around the base of a large orange tree; Jerusalem cherry bushes and nursery trees of the orange and peach were treated with from one to two quarts of the solution. The orange tree was severely injured, some of the nursery stock was killed while the Jerusalem cherry bushes were injured more or less. This result would appear to demonstrate that the solution is injurious to plant life, which fact would place a limit upon its usage. The cost of the solution is from 1½ to 2 cents per gallon.

The use of potassium in powdered form for the destruction of ants was recommended in 1904 by Prof. H. A. Gossard in Bulletin 76, Florida Agricultural Experiment Station, pages 215–16. The trial of this substance against white ants is suggested in 1905 by the same

writer in the Florida Bulletin 79, page 313. Professor Gossard also mentions this method of destroying ants in the third issue of the JOURNAL, June, 1908, page 190. A solution possesses certain advantages over a dry powder. There is no danger for example of chickens picking up the particles if the former is employed. It is evident that this insecticide can be used to some extent at least against subterranean insects. More experiments are necessary to determine the limitations of this powerful insecticide along this line.

E. P. FELT

THE ECONOMIC ENTOMOLOGIST IN BUSINESS

By H. L. FROST, *Arlington, Mass.*

Each year as transportation facilities improve and natural products from all parts of the globe are assembled in one place, the problems of the economic entomologist are increased. With the changes of habitat of the various species of plant growth comes the unbalancing of Nature's control of both injurious and beneficial insects. Thus, the entomologist of today cannot be simply the man of scientific knowledge, but must debase his profession by combining his science with practical business in order to fill his position to the best advantage. Will he gain or lose by this change? His remuneration will be increased to a greater or less extent according to his business ability, but his glory of achieving honors by scientific research will be lessened because of his lack of time to carry on both branches of the work.

It is the purpose of this article to show in brief the great need of commercial economic entomologists. The profession is in its infancy and might be compared to the day of the medical profession when the patient was bled for every disease. Injurious insects have increased faster than remedies or natural enemies, and this is the problem to be overcome by our scientific and trained men. The value of all kinds of trees which suffer most from insect depredations has developed a hundred fold in the last decade. Owners everywhere are calling in vain for help to save trees which have required years to mature.

Fortunately, we have had a generation of scientific men, peers to none, who have devoted their lives to the study of insects. They have given and are giving us information, which is both complete and accurate. Our failure is our inability to make use of this research by securing and applying practical remedies. This is the field which offers unlimited opportunities to the present generation.

A proper preliminary training will be found of great service, but should be very broad in order to make a success of this work. Even

with this preparation one is, in reality, dependent to a great degree upon the specialists who are devoting their lives to the scientific study of insects. The average land owner is not equipped by either training or experience for carrying out the ideas of the economic entomologist. He requires a specialist who can accomplish the desired end. Unless injurious insects are checked our fruit trees, many of our ornamental trees, and, in New England, our forest trees, will be largely destroyed. The scientist, chemist, and trained workman, must all combine forces if the loss to agricultural interests is to be reduced.

No one should undertake a business of this description without supplementing his entomological training with a knowledge of some affiliated subject, such as Horticulture, Forestry, or Tree-surgery. His work of fighting insects, as a rule, covers only a short season, and must necessarily be carried on with the least possible delay. In the East, unfavorable weather conditions may deprive him of all his profits. On the other hand, very favorable conditions will give him most remunerative returns. Thus, he should make one of the above-mentioned branches the basis of his business, using his entomology as his speculative step toward the success of his enterprise.

As an illustration: A man owns a valuable orchard which is being stripped by the canker worm. He calls in a contractor, who recommends spraying with an arsenical poison. The season is so wet while the insect is feeding that it is impossible to do any spraying, and, consequently, the job is lost. If the contractor is equipped for horticultural work, he can benefit the orchard in other ways, even though he was unable to check the ravages of the insect. He will secure immediate results by pruning, fertilizing, and improving the general health of the trees, thus making them better able to resist insect attacks.

This is one instance where he has lost nearly his entire spraying season, which happens about once in seven or eight years. The strongest argument against his depending on entomological work alone is the necessity of his having skilled men. In fighting insects, a very high standard of trained laborers is required to obtain the best results. It is impossible to hold such men without giving them steady employment. To do this, work must be secured which can be held over, without injury to the tree, to be carried on at the convenience of these workmen. Tree-surgery or affiliated branches make this plan possible.

The business of caring for trees has made a tremendous advancement in the last ten years, but we still have many problems to solve. The least progress has been made in handling the various insects, as

there are still many pests which cannot even be suppressed. Chemicals used for spraying purposes very often act differently under different climatic conditions. Whether this is due to chemical changes in the poisons or to varying pathological conditions seems to be unknown. For example, tests have been made of nearly every brand of arsenate of lead (supposed to be a perfectly safe poison) and in each case, under certain conditions, burning of the foliage has resulted. If our most perfected remedy cannot be depended upon under all conditions, even when applied by trained men, the great necessity of advancement is readily apparent. This can be assured only by the entrance into business of economic entomologists.

MUST THE CALYX CUP BE FILLED?[1]

By M. V. Slingerland, *Cornell University*

More than a decade has elapsed since I studied the codling-moth and monographed the then existing knowledge of the insect in Bulletin 142 of the Cornell Agricultural Experiment Station. Since then I have closely followed the excellent work done, both in the East and the far West, by which much new information has been gleaned regarding the life-history and methods of controlling this pest. But I was hardly prepared for the accusations that Eastern entomologists were lax and not up to date in their advice to their constituents, as set forth in the article entitled "Filling the Calyx Cup," in the June, 1908, number of this Journal.

Fortunately I had been making some photographs of the calyx ends of developing apples for my class work when the above article appeared. The pictures at A, A, A, A, B and C on the plate well illustrate the outer and inner calyx cavities, which are separated by the ring of stamens, with the large fleshy pistil extending up through the center. The bases of these stamens set very closely together and come up close around the pistil. I was also surprised to find that even after their tips had withered and the calyx lobes had closed in, the stamens remained fresh and plump at the base, and around the pistil, and thus still formed a partition or wall between the two cavities, as shown at C. In fact so tight a barrier did the stamens form between the two cavities that I became a "doubting Thomas" as regards the assertions of some entomologists that it was absolutely necessary to drench a tree with a spray sufficiently forceful to drive the

[1]Contribution from the Entomological Laboratory of Cornell University.

poison into the lower calyx cavity in order to obtain satisfactory results against the codling-moth.

After reading the assertive and accusing article above mentioned, on June 27, I went to Nature for the facts as regards the feeding habits of the young codling-moth larvæ. Do they feed any in the upper calyx cavity after squeezing through between the closed calyx lobes? Or do they go on down through the closely set row of stamens into the lower calyx cavity for their first meals? The answer to these questions would determine if it was necessary to drive the poison spray into the lower calyx cavity.

I found that in every case where the young larva had entered the apple at the calyx end it had stopped to feed in the outer calyx cavity. Furthermore, the larva had fed in the outer cavity for several days, or through the first larval stage. The only ones I found going farther into the apples had a head diameter of about .54 mm., which corresponds almost exactly to Simpson's recorded diameter for the head of codling-moth larvæ in the second stage. At D on the plate is shown such a larva in the second stage that was just going into the lower calyx cavity. It had fed quite extensively around in the upper cavity, partly on the fleshy stamens, and a few pellets of its excrement had dropped into the lower cavity. I was unable to obtain any evidence that the larvæ worked their way into the lower calyx cavity without first taking several meals in the outer cavity. Several other Eastern entomologists with whom I have discussed these facts have made similar observations. The young codling-moth larvæ may have different feeding habits in recently-set apples in the far West, but thus far I have not seen any definite facts or pictures to prove that they do not first stop to feed in the outer calyx cavity when they enter young apples at this point.

Remarkable results have been recorded from thorough, drenching, forceful arsenate of lead sprays in the West, perhaps better results than Eastern fruit-growers usually get, but is it not due more to the thoroughness and method of application than to the 200 pounds of pressure which is supposed to be necessary to drive the spray into the lower calyx cavity? All entomologists and many progressive fruit-growers now understand the great importance and necessity of the application of a poison spray for the codling-moth soon after the petals have fallen and before the calyx lobes close up. But there still remain many apple growers who do not spray thoroughly enough or direct the spray properly into the calyx cups, and it is not because of the laxity or proper advice of entomologists. Such is human nature.

Finally, from recent codling-moth literature and from the facts I

have been able to glean from Nature (as illustrated in the figures on the plate), I am not yet convinced that it is wise to assert that a fruit-grower must drench his trees with arsenate of lead only and that the spray must be applied with a force necessary to drive it into the lower calyx cavity of young apples. The evidence submitted in Bulletin 131 of the Colorado Experiment Station to show that fruit trees are being poisoned and killed by excessive use of poison sprays should be seriously considered by both entomologists and fruit-growers in alkaline regions. Under similar conditions cannot just as satisfactory results be obtained against the codling-moth with either Paris Green or arsenate of lead applied as a fine spray in moderate quantities evenly over the trees, at about 100 pounds pressure, if the spray is properly directed downward into the open outer calyx cavities of the recently-set apples? I have not yet seen sufficient evidence to warrant entomologists in answering this question in the negative.

THE ARMY WORM AT DURHAM, NORTH CAROLINA

By Z. P. Metcalf, Assistant Entomologist, State Department of Agriculture, *Raleigh, N. C.*

The occurrence of the Army Worm (*Heliophila unipuncta*) in destructive numbers at Durham, in the east central part of this state, on August 9, 1908, presented three interesting points:

(1) The occurrence of this species so far south and so far east in the state; (2) its occurrence so late in the season; and (3) the per cent of worms parasitized.

Our office records covering the last eight years show that this insect does not occur in destructive numbers very far east of the mountains. It was reported as being injurious in May, 1907, from the extreme southwestern portion of the state.

Although the Army Worm has been reported as being destructive as late as the last of September, it rarely occurs in injurious numbers after the last of July.

As is usual during such outbreaks, large numbers of Tachina flies (*Winthemia quadripustulata*) were to be found in the fields laying eggs on the worms. With the intention of making a more careful study of these parasites 491 larvæ were brought back and placed in cages. The following data gleaned from the records of these cages are presented as being of some interest. Of the 491 larvæ, 442 were infested with the eggs of the dipterous parasite, *Winthemia quadripus-*

Must the Calyx Cup be Filled?

tulata, leaving only 49 larvæ, or 10 per cent of the whole number, uninfested; yet 61 larvæ were able to pupate. From these 61 pupæ, however, only 7 adult moths emerged, showing a total mortality among the Army Worm from larva to adult of 98.6 per cent. And since 90 per cent of the larvæ were infested with the eggs of this parasite, it would seem to indicate that, in this case at least, the parasitic fly was decidedly the most important factor in causing the high mortality of the Army Worm. In a few cases it was found that where only a single parasitic egg was attached to a larva, that the host was able to complete its transformations.

The greatest number of parasitic eggs observed on a single larva was 12, with an average of 3 for the entire number (442) infested. The 442 infested larvæ yielded 709 parasitic puparia, or an average of nearly two for each infested larva. The 709 puparia yielded 556 adult parasites. The greatest number of adult flies from a single Army Worm was four. These figures show that the mortality with the parasitic fly from egg to puparium was 52 per cent, and from puparium to adult 22 per cent, making a total mortality from egg to adult of 73 per cent.

This shows that the tendency would be for the fly to continually gain in relative numbers, owing to the lighter mortality, and easily accounts for the complete subjugation of the Army Worm in normal years by this one natural enemy. No other parasites were found in the course of these experiments.

NOTES ON THE HEN FLEA (XESTOPSYLLA GALLINACEA)

By Glenn W. Herrick

During the summer of 1907 the ground beneath one of the dwelling houses on the campus of the Mississippi Agricultural College became infested with fleas to such an extent that the occupants were greatly annoyed by these pests. On examination I found that two species were present beneath the house, namely, the hen flea and the dog flea. The house, of course, stood on brick pillars some distance above the ground, and thus gave opportunity for hens to go under, where they would lay eggs and rear chickens. Dogs and cats also had free access to the space beneath the house. To secure relief the space under the house was treated with a thorough dusting of slacked lime and nothing more was heard from the occupants until the summer of 1908, when the fleas again became troublesome.

On investigation a hen was found sitting beneath the house and she and her nest were literally alive with the hen flea. *Xestopsylla gallinacea.*

I do not mean to say positively that this flea was annoying the occupants of the house, for no specimen of this particular species was ever found by me in the rooms. In fact, I was unable to get hold of any of the specimens in the house that were actually causing the trouble.

The fleas on the hen were confined to the face, ear lobes and wattles. These parts of the fowl were almost black with them. By actual count there were 164 on the right wattle, 65 on the right ear lobe, and by estimate, 200 or more on the right side of the face. The pests stood at right angles to the surface, with their heads embedded in the skin, nor were they at all easy to remove. They could not be brushed off nor scraped off with a knife without hurting the hen. I removed some with tweezers, but even with these instruments they came off with difficulty.

We placed the fowl in a large box containing some sawdust and kept her there several days, during which time she managed to free herself from a good many by scratching her head with her toes, and I suspect some of the older, engorged females dropped off to deposit eggs.

I dissected some of the engorged females and found they contained, apparently, well developed eggs. In one I found three white oval-shaped eggs. In another I found five. On June 22 I placed two engorged fleas in each of three vials. On the morning of June 23 (8.30) I found five eggs in vial *a*, five eggs in vial *b*, and three eggs in vial *c*. The eggs were white, oval and considerably longer than broad. They measured from .35 to .4 mm. in length. It appeared so easy to obtain the eggs that I thought a more extended observation might be worth while.

Accordingly, on the morning of June 23 I placed one large, apparently engorged female flea in each of fifteen vials, to ascertain their egg-laying capacities. To my surprise and gratification, eggs were obtained in every case but one and in most cases the larvæ hatched readily, as shown by the following table:

Oviposition Record of Hen Flea.

June 23.	June 24.	June 25.	June 26.
Fleas placed in vials.	No. eggs.	No. eggs	No. larvae hatched.
Vial a.	2	2	2
Vial b.	2	2	1
Vial c.	1	1	0
Vial d.	3	3	3
Vial e.	4	4	0
Vial f.	7	7	5
Vial g.	3	3	0
Vial h.	1	1	1
Vial i.	4	4	1
Vial j.	4	4	2
Vial k.	5	5	3
Vial l.	4	4	1
Vial m.	2	2	0
Vial n.	1	1	0
Vial o.	3	3	2

It will be seen from the foregoing table that the fleas laid all of their eggs on the day following their placement in the vials and that the larvæ hatched within forty-eight hours after the eggs were deposited. At 9.30 a. m. on June 26 I found most of the larvæ just wriggling out of the egg shells. Some had not yet gotten clear of the shells.

The larvæ were white, very active and from 1.5 mm. to 1.8 mm. in length. They were nearly of the same diameter throughout, with the thorax slightly larger.

I placed them in separate vials along with sawdust, feathers and filth, but, owing, very likely, to unfavorable conditions of moisture and temperature, none of them developed.

Professor Osborn in Bulletin 5, n. s., of the U. S. Bureau of Entomology, p. 145, quotes the observations of Judge Johnson on the life-history and habits of this flea. Judge Johnson says regarding them that "the females bury themselves in the skin of their victims. From the first they hold on with such tenacity that no ordinary brushing will remove them. It seems to be at this stage in their existence that impregnation takes place. The males now are often seen in copula with them and so remain apparently for days, or until the tumefac-

tion of the skin excited by the embedded female closes around her so as to shove them off. Here ends about all actually known of their history." From my observations this account is very probably accurate, except the latter part. I found the males present on the head of the fowl, but did not actually observe them in copulation with the females, although fecundation must have taken place under these conditions. So far as my observations go, however, no tumefactions of the skin of the fowl take place. Judge Johnson farther says: "From analogy we may infer that the period of gestation being completed, the gravid female lays her eggs in this well prepared nidus, or more particularly that they remain or are hatched in her distended stomach, after which they crawl out and drop to the ground."

From the ease with which the females were induced to lay eggs in the vials, I believe they simply drop off when engorged, like a cow tick, and lay their eggs among the debris in the nests of the fowls. At no time was there a tumefaction of the skin or a so-called nidus formed. It seems to me that Judge Johnson must have ascribed the disease known as "the wart disease" to this flea or possibly confused it with that of *Sarcopsylla penetrans*.

Scientific Notes

Toxoptera graminum Rond. has been found very generally distributed over Minnesota during the last summer, wherever wheat is grown, and eggs which were collected out of doors in the early spring near St. Anthony Park hatched in due season, showing that the species can survive our winters, or at least, did survive last winter. Insectary work upon this insect shows it to be much more prolific than *Macrosiphum granaria*.

Three species of locust, namely *M. femur-rubrum*, *M. atlanis* and *M. bivittatus*, have been locally quite destructive in Minnesota this season.

In work with stalk borers, Genus *Papaipema*, during the summer several species have been found to be common in Minnesota, among them *P. furcata* has injured hundreds of young ash in nursery rows by boring in the center, and so weakening the tree that a slight wind breaks it.

F. L. Washburn, *St. Anthony Park, Minn.*

NOTES AND DESCRIPTIONS OF SOME ORCHARD PLANT LICE OF THE FAMILY APHIDIDAE

By C. P. Gillette

(*Continued*)

The Green Peach-Aphis, *Myzus-persicae*, Plate 8, Figs. 4 to 11.

Some of the More Important Literature

Aphis persicæ Sulz., Kennzeichen Insecten, p. 105, 1761.
Aphis dianthi Schr., Fauna Boica, II, 1801.
Aphis dianthi Schr., Monographie der Fam. Pflanzenlause, Kalt., p. 42, 1843.
Rhopalosiphum dianthi Schr., Die Pflanzenlause, Koch, p. 42, 1857.
Myzus persicæ Sulz., British Aphides, Buckton, I, p. 178, 1876.
Megoura solani Thos., Eighth Rep. Ent. Ill., p. 73, 1879.
Myzus persicæ Sulz., Thomas, Eighth Rep. Ent. Ill., p. 76, 1879.
Siphonophora achyrantes Monell, Bull. U. S. Geol. Sur. Vol. V, No. 1, p. 18, 1879.
Myzus malvæ Oest., Geol. Sur. Minn., 14th Rep., p. 31, 1886.
Myzus persicæ Sulz., Taylor, Jour. Ec. Ent., I, p. 83, 1908.
Myzus persicæ Sulz., Gillette and Taylor, Bull. 133 and 134, Colo. Exp. Sta., 1908.

This louse has the widest range of food plants of any species known to me, and it is peculiar in possessing cylindrical cornicles in the spring migrant and distinctly swollen cornicles in the return migrant and the male in the fall. This difference in cornicles, the wide range of food plants, and the remarkable variations in color, together with only a partial knowledge of the life-history by the different writers, fully explain how it is that this louse has been described under so many different names in Europe and America.

Young Stem-Mother—before first moult; Plate 8, fig. 4.

Specimens from peach and native plum, Fort Collins, Col., March 25, 1908. Color dull and rather dark green, becoming lighter, tinged with yellowish, as it feeds and grows; head, legs and antennæ somewhat dusky brown in color; on the middle of the head a pale median line; eyes dark red.

MEASUREMENTS OF SIX STEM-MOTHERS THAT HAD GROWN LITTLE IF AT ALL, RAN AS FOLLOWS:

Body.	Antenna.	Antennal Joints.	
		Left Side.	Right Side.
.72mm	.35mm	5	5
.65	.35	5	6
.61	.35	5	5
.62	.35	5	5
.65	.34	..	..
.72	.35	..	..

A larger specimen that possibly had shed once measured .80 mm., and the antenna .45 mm.; joints of antenna 6 on each side; others, as shown above, were mostly 5-jointed on each side. The .80 mm. louse began to show the carneous color, which usually appears after the first molt. Cornicles short, keg-shaped, being slightly bulged in the middle; length .03 mm.; antenna hairless; 3d joint about equal to 4 and 5 combined; body smooth, free from hairs and without distinct markings.

Adult Stem-Mother—Plate 8, fig. 5.

Specimens taken in peach blossoms, Fort Collins, Col., March 30, 1907.

Length of body varying little from 1.70 mm., width 1 mm.; length of antenna .80 mm.; cornicles .14 mm., cylindrical or slightly clavate; antennal joints: III, .33; IV, .16; V, .13; VI, .17 mm.; 5th joint barely larger than base of 6th; no indication of joint being divided into two; one sensorium near distal end of 4th joint, and the usual cluster on the 5th; color pale green, more or less washed and mottled with light salmon. In many cases the red color predominates, and in others the green. Cornicles rather strongly converging, slender, slightly larger at base, black at extreme tips; legs very pale, with distal ends of tibiæ and tarsi black; antennæ very pale, a little dusky towards distal ends; no thoracic or abdominal tubercles, antennæ on moderate though well developed tubercles; cauda slightly curved upwards and with velvety appearance, due to the surface being densely set with minute points; beak barely attaining hind coxæ, and black at extreme tip.

Apterous Viviparous Female, Second Generation—Plate 8, fig. 7.

Specimens taken from peach leaves, Fort Collins, Col., September 16, 1908.

General color a very pale yellowish green without black markings, even upon the legs; eyes dark red. These females usually exhibit one or more small red dots on the abdomen, due to the colors of the eyes of the embryos. General shape of the louse rather long and tapering posteriorly; surface of the body finely reticulated; length of body 1.86 and greatest width 1 mm.; antennæ 2.09 mm.; joints: III, .43; IV, .31; V, .57; VI, .10; VII, .88 mm.; cornicles .60 mm.; hind tibiæ 1 mm.; antennæ upon rather strong frontal tubercles; first joint of the antennæ with a prominent angle or gibbous enlargement; prothorax without lateral tubercles; a few scattering hairs upon the body, most of which are capitate. The cornicles are slender, nearly uniform in diameter throughout, slightly swollen on the inner margin near the distal end, at which point they curve slightly outward.

The summer apterous females upon various vegetable and greenhouse plants differ from the spring form by being pale yellowish in color and having the median and two dorsal longitudinal green stripes upon the abdomen obscure or wanting.

Spring Migrant—Plate II, fig. 8; Plate 6, figs. 11, 12.

The spring migrant differs from the fall migrant described below by being more green in ground color, having the dark markings blacker and more extensive, the cauda and cornicles being black or blackish, and, most important of all, the cornicles are cylindrical.

Winged Viviparous Female, Fall Migrant—Plate 8, fig. 9. Plate 6, figs. 13, 14.

Specimens taken at Fort Collins, Col., October 13, 1906, from plum, peach and cherry trees.

Head, entire thorax above, mesothorax below, distal portions of all femora and tibiæ, the tarsi, antennæ and a large spot on the pleurum beneath the insertion of the fore wing black or blackish; abdomen pale yellow or greenish yellow, with a large dusky brown patch upon the dorsum of segments 4, 5 and 6, and often extending upon segments 3 and 7; spots of a similar color upon the lateral dorsal margins of segments 2, 3 and 4; the metasternum, genital plates, middle and hind coxæ, cornicles, style, distal half of beak, and sometimes two or three spots on either side of venter, dusky brown; eyes very dark red; stigma of wing slightly dusky; third joint of the antennæ lighter than other parts; lateral tubercles of thorax wanting, or appearing as very small points; length of cauda .14 mm.; cornicles distinctly constricted in basal half, giving them the form of a ball club. Joint 3 of the antenna with 10 to 12 circular sensoria in a single row. No others except the regular ones on joints 5 and 6; see Plate 6, fig. 14.

MEASUREMENTS IN MILLIMETERS OF FOUR NORMAL SPECIMENS

Body.	Antenna.	Wing.	Cornicles.
1.8	2.2	3.7	.36
2.1	2.7	4.0	.43
1.8	2.3	3.6	.38
2.0	2.3	3.7	.41

MEASUREMENTS OF ANTENNAL JOINTS IN MILLIMETERS

Jt. 1.	Jt. 2.	Jt. 3.	Jt. 4.	Jt. 5.	Jt. 6.	Jt. 7.	
.08	.06	.54	.42	.32	.16	.58	
.08	.06	.52	.40	.30	.14	.56	
.08	.06	.52	.38	.30	.16	.56	
.10	.06	.52	.40	.32	.14	.56	
.085	.06	.525	.40	.31	.15	.565	Averages.

Oviparous Female—Plate 8, fig. 10 and Plate 6, figs. 16 and 17.

Specimens from peach and native plum, Fort Collins, Col., November 2, 1906.

The young, when first born, are green with red eyes, but soon change as they grow to bright flesh or even salmon-colored apterous individuals, with distal half of antennæ, tarsi and extreme tips of cornicles black or dusky. The cornicles of these apterous females, when resting quietly, usually converge strongly towards their tips, lying close to the sides of the body, and each is bent distinctly outward near the distal end, where they are usually a trifle thicker than near the proximal end. Fully grown examples are

bright salmon red in color. The antenna is about two thirds as long as the body, or approximately 1.45 millimeters; length of body 1.70 to 2 mm.; cornicles .33 mm. I have not been able to see any sensoria upon 3d joint of antenna, but about 25 small circular sensoria occur upon each hind tibia. See Plate 6, figs. 16 and 17.

The eggs are deep green when first laid but become shining black in a few days. They are .66 mm. long by .33 mm. broad and are deposited chiefly in the axils of the buds. See Plate 8, fig. 11.

Male.

Taken on peach leaves by L. C. Bragg, Ft. Collins, Colo., November 4, 1908.

Colors practically the same as in spring migrant but with the black or blackish markings, at least in some specimens, more extensive; cornicles dusky to black, moderately swollen, as in fall migrating female. Lengths: Body, 1.85 mm.; wing, 3.20 mm.; cornicles, .34 mm.; antenna, 2.30 mm. Joints: III, .56; IV, .49; V, .40; VI, .14; VII, .60 mm. Numerous small circular, moderately tuberculate sensoria upon joints 3, 4 and 5. See Plate 6, fig. 15. Frontal tubercles and 1st antennal joints are rather strongly swollen.

The male is a fall migrant, going to the trees from the summer host plants, and is not the offspring of the female fall migrant. The latter gives birth to the apterous oviparous females only.

The Black Cherry Louse, *Myzus cerasi* Fab.; Plate 8, Figs. 1, 2, 3.

Some of the More Important Literature

Aphis cerasi Fab. Syst. Ent., p. 734, 1822.

Aphis cerasi Fab. Kaltenbach, Mon. Fam. Pflanzenlause, p. 45, 1843.

Aphis cerasi Fab. Koch, Die Pflanzenlause, p. 87, 1857.

Myzus cerasi Fab. Buckton, British Aphides, V. I, p. 174, 1876.

Myzus cerasi Fab. Fitch, Cat. Homop. N. Y., 1851 (Lintner's 9th Rep. Ent. N. Y., p. 405).

Myzus cerasi Fab. Thomas, Ent. Ill. 8th Rep., p. 75, 1880.

Myzus cerasi Fab. Oestlund, Aph. of Minn., p. 73, 1887.

Myzus cerasi Fab. Weed, C. M., Bull O. Expt. Sta. Tech. Ser., V. I, No. 2, 1890.

Myzus cerasi Fab. Theobald, Rep. Econ. Zool., p. 48, 1908.

This coal black louse is the only aphid of any importance as a pest upon the cultivated cherry in Colorado. It continues upon cherry foliage throughout the season and neither my assistants nor myself have been able to discover it upon any other tree or plant.

EXPLANATION OF PLATE

PLATE 8: Figs. 1–3 *Myzus cerasi;* 1, adult, apterous viviparous female; 2, winged viviparous female; 3, winged male. Figs. 4–11 *Myzus persicæ;* 4, young stem-mother; 5, adult stem-mother; 6, recently hatched young of stem-mother; 7, apterous viviparous females, second generation; 8, spring migrant; 9, winged viviparous female, fall migrant; 10, oviviparous female; 11, egg. Figs. 12–15 *Hippodamia convergens;* 12, adult; 13, larva; 14, pupa; 15, cluster of eggs. M. A. Palmer, artist. Original plate in Bul. 133, Colo. Exp. Station.

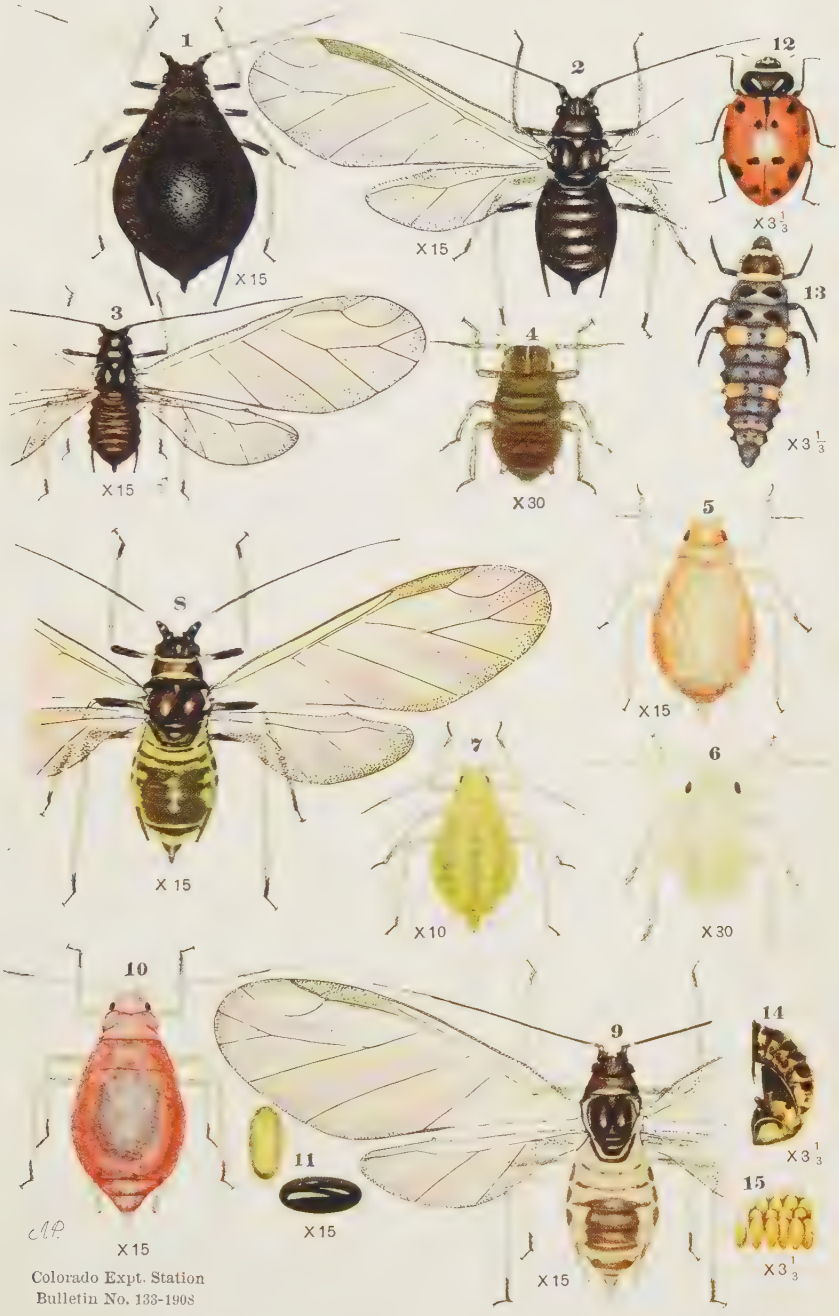

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PLATE II PLANT LICE

M.-N. WORKS
BUFFALO

Adult Apterous Viviparous Female—Plate 8, fig. 1.

From specimens taken at Fort Collins, April 18, 1908.

Color deep shining black with tibiæ, anterior femora and basal portion of antennæ beyond 2nd joint, pale dusky yellow: surface of body finely rugulose; measurements vary little from the following: Body 1.90 mm. by 1.40 mm.; antennæ 1.25 mm.; cornicles .50 mm.; cauda short, conical, .17 mm. in length. Joints of antennæ: III, .36; IV, .21; V, .18; VI, .10; VII, .25 mm. The cornicles taper a little towards tip and near the end are distinctly constricted and turned outward and have a moderate flange at end. Body and antennæ without hairs, and the hairs on legs short and weak; no tubercles upon thorax or abdomen, except in some specimens upon joint 7 of the abdomen, as shown in colored figure. When at rest the cornicles usually converge strongly, almost touching at their distal ends. Antennæ upon distinct frontal tubercles which are moderately swollen, as are the first antennal joints on the inner side.

Winged Viviparous Female.

Described from specimens taken at Fort Collins, September 28, 1907.

General color deep black, with the tibiæ and basal portions of the femora pale yellowish in color; prothorax with slight lateral tubercles or none; cornicles cylindrical, black, with moderate flange at distal end and varying little from .37 mm. in length; cauda black, up-turned, tail-like, about as long as hind tarsus; length of body varying little from 1.40 mm.; antenna a little longer than body, averaging about 1.70 mm.; joints measure approximately as follows: III, .50; IV, .31; V, .24; VI, .13; VII, .43 mm. Wings about 2.80 mm., stigma of wing blackish; venation normal; third joint of antenna with about 14 moderately tuberculate sensoria in a broken row and none upon joint 4.

Winged Male.

Specimens taken from sour cherry, College orchard, Fort Collins, Col., November 17, 1907.

Length 1.30 mm.; general color deep black, the abdomen a little lighter than the other portions of the body and in some specimens appears to be dusky brown, with narrow transverse bands upon the segments between the cornicles, and back of them it may be entirely black; eyes very dark red; tarsi and distal portions of tibiæ and femora black; prothorax with lateral tubercles weak or lacking; wings hyaline, stigma a little dusky brown, nervures dark brown; length of antenna 1.70 mm.; joints of antenna: III, .40; IV, .28; V, .23; VI, .11; VII, .50 mm.; length of wing 2.50 mm.; length of cornicles .23 mm., cylindrical and black. Joints 3, 4 and 5 are strongly tuberculate, with a large number of similar circular sensoria. The sensoria are most abundant on joint 3. Antennæ on distinct frontal tubercles that are slightly swollen, first joint distinctly gibbous.

Aphis bakeri Cowen

Some of the More Important Literature

Aphis bakeri[1] Cowen, Bull. 31, Tech. Ser., Colo. Ex. St., p. 118, 1895.
Aphis cephalicola Cowen, *ibid.*, p. 118.
Aphis bakeri, Hunter, Aphid. N. A., Bull. 60, Ia. Ex. St., pp. 93, 132, 1901.
Aphis cephalicola, Hunter, *ibid.*, pp. 95, 132.
Aphis bakeri, Sanborn, Ks. Univ. Sci. Bull., Vol. III, No. 8, pp. 251, 255, 1906.
Aphis cephalicola, Sanborn, *ibid.*, pp. 251, 256.
Aphis bakeri, Gillette & Taylor, Bull. 133, Colo. Ex. St., p. 28, 1908.

Mr. Cowen collected this louse from stems of red clover (*Trifolium pratense*), and from the heads of white clover (*T. repens*). During the past three years we have taken this louse many times in the vicinity of Fort Collins, Denver, Delta, Paonia, Montrose, Grand Junction and Rocky Ford, Colorado. It occurs early and late in the season in greatest numbers upon the stems of red clover close to the ground, where, in mild seasons at least, it doubtless spends the winter as viviparous females and young. It has lived and done well all winter upon clover plants brought into the laboratory by Mr. Bragg.

As I have succeeded, with the aid of good observers, in working out the life history of this louse quite fully, a list of our written records for Colorado might be worth printing. The additional observations that we have made, but which have not been written down, far exceed the written records which follow in chronological order, disregarding the year:

March 22, '07, Fort Collins, apterous and alate females and alate males, on red clover (insectary).—Bragg.
April 2, '08, Fort Collins, apterous females on *Bursa B.-pastoris*.—Bragg.
April 11, '08, Eckert, stem-mothers, young to fully grown, also some 3d generation lice half grown on pear buds.—Gillette.
April 13, '08, Delta, stem-mothers, small to fully grown, many examples on pear and apple buds.—Gillette and Weldon.
April 26, '08, Fort Collins, alate and apterous females, on apple (insectary).—Gillette.
May 9, '07, Fort Collins, apterous and alate females, on sweet clover.—Gillette.
May 15, '07, Fort Collins, alate and apterous females on red clover.—Gillette.

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[1]It is not improbable that Oestlund's *A. trifolii* was an immature apterous example of this species, but *trifolii* was given as a root louse, which *bakeri* is not; neither is it pulverulent, and the mere statement that it was a pink louse, quite similar in other respects to *A. middletoni*, does not seem to be a characterization sufficient to identify it.

May 21, '08, Delta, apterous and alate females on apple.—Gillette and Weldon.
May 22, '08, Cory, stem-mothers and alate females, on apple and pear.—Gillette and Weldon.
May 22, '08, Austin, Delta County, apterous and alate females, on pear and apple.—Gillette.
May 26, '08, Rocky Ford, pupæ and winged females on apple.—Bragg.
June 8, '08, Fort Collins, apterous and alate females on *Crataegus occidentalis,* very abundant.—Gillette.
June 22, '08, Fort Collins, apterous and alate females on red clover.—Gillette.
July 8, '08, Fort Collins, apterous females on apple.—Gillette.
July 10, '08, Grand Junction, alate females on apple, very scarce.—Weldon.
July 12, '08, Delta, alate females, on apple.—Weldon.
Aug. 3, '98, Fort Collins, apterous and alate females on red clover.—Gillette.
Aug. 16, '08, Fort Collins, apterous females on apple sprouts.—Gillette.
Aug. 21, '08, Paonia, apterous and alate females, on red clover.—Weldon.
Sept. 28, '08, Fort Collins, apterous and alate females on red clover.—Gillette.
Oct. 1, '08, Grand Junction, return migrants and young oviparous females, on apple and pear.—Weldon.
Oct. 6, '08, Delta, return migrants, male and female, on apple.—Weldon.
Oct. 14, '08, Fort Collins, apterous and alate females on red clover.—Gillette.
Oct. 22, '06, Fort Collins, apterous and alate females on red clover.—Bragg.
Oct. 26, '08, Delta, return migrants, male and female, and oviparous female, also eggs, on apple.—Weldon.
Oct. 29, '06, Fort Collins, alate males, and apterous and alate females on red clover.—Bragg.
Oct. 31, '06, Fort Collins, alate and apterous females on red clover.—Bragg.
Nov. 4, '08, Delta, return migrants, male and female, and oviparous females, on apple.—Weldon.
Nov. 8, '08, Fort Collins, return migrants, male and female, and oviparous females, on *Crataegus occidentalis.*—Miss Palmer.
Nov. 26, '06, Fort Collins, alate males and females and apterous females, on red clover.—Bragg.

I have also received examples of this louse from Mr. J. T. Monell that were labeled "Manhattan, Kansas, 8–27–'08, Ainsley; taken on red clover"; and specimens from Mr. J. J. Davis marked "Urbana, Illinois, 3–11–'08; on clover, in insectary."

From our records and observations there seems to be no doubt but what this louse spends the winter chiefly in the egg stage upon apple,

pear and *Crataegus;* but also, to some extent, upon the clovers, and in some cases upon *Bursa,* as alate apterous and viviparous females and young, when given sufficient protection and when the weather is not too cold. The stem females hatch very early, so that many are fully grown and giving birth to young by the time the apple buds begin to open. The fully developed stem-mother is usually rather dark red in color.

Winged spring migrants begin to appear in considerable numbers in the second generation, and are abundant in the third generation. By June 30, they have nearly all left the trees, but small colonies do sometimes continue throughout the season upon the apple. The spring migrants go to the clovers as their summer host plants, and the female fall migrants begin returning to the apple, pear and *Crataegus* about the last of September. A little later the alate males which develop upon the summer food plants, follow to fertilize the apterous oviparous females, which are the offspring of the fall migrants. The oviparous females begin to deposit eggs about October 20. Mr. George P. Weldon reported finding the first eggs at Delta, Colorado, on October 26, and states that they are at first green like the eggs of *Aphis pomi,* but soon become black.

The striking characters which readily separate this species from others that infest the apple and pear are the light yellow to pink color of the body in the larvæ and apterous adults; the minute dark specks which occur upon the dorsum of the apterous forms, both larvæ and adults; the large dark green to blackish quadrate patch upon the dorsum of the alate forms; and the short cornicles. In case of the larvæ and apterous lice there is also a light area at the base of each cornicle which is often quite conspicuous.

During last spring this louse was the most abundant species upon the apple and pear trees on the western slope in Colorado.

Adult Stem-Mother—Plate 9, figs. 1 and 5.

Specimens taken at Eckert, April 11, 1908.

Ground color dark green at first, and more or less streaked and mottled with deep red both above and below, but there is much more red on the dorsal than on the ventral side; cornicles and cauda very short and pale yellowish green, almost colorless; legs and antennæ pale green, with distal ends of the tibiæ and antennæ and the tarsi black; general form rather long and tapering posteriorly when just mature; old lice more robust and nearly all dark red, even legs, prothorax and antennæ in some cases; length of body about 1.90 mm.; antenna .70 mm.; joints: III, .37; IV, .13; V, .11 mm. There is some variation in length of antenna and in some cases joint 3 is divided into two making 6 joints. In some cases there will be 5 joints in one antenna and 6 in the other on the same louse. Near the end of joint 3 (or

4 if 6-jointed) is the large sensorium which commonly occurs upon joint 5 in the aphididæ; length of cornicle .11 mm., stout, tapering, largest at base.

Apterous Viviparous Female—Plate 9, fig. 2.

Specimens from clover, Ft. Collins, June 23, 1908.

General color pale yellowish or greenish yellow, with a slight tinge of pink or light orange, especially in the region of the cornicles; upon the dorsum a sprinkling or mottling of dark green or rusty brown specks irregularly distributed, and in some the faint dusky specks at the bases of the abdominal hairs also show; in some of the older individuals, the dark markings form a transverse dash upon the segments posterior to the cornicles, and joints 1 and 2 of the antennæ and the dorsum of the head are often blackish. The large yellow to pale orange blotches surrounding the cornicles are not as sharply outlined as in the larvæ and pupæ; cauda and cornicles entirely concolorous with body, not marked with black; distal half of antenna more or less blackish; distal ends of all tibiæ, the tarsi and tip of beak black; eyes appearing black but really very dark red; length of body 1.70 to 2.20 mm.; length of antenna .90 to 1.10 mm.; cornicles .11 to .14 mm.; joints 3 and 7 of antenna sub-equal, either being a trifle longer than the other.

Pupa.

Specimens taken with the preceding apterous females.

The pupæ in all stages are decidedly pink in color and the deeper color markings that are usually deep green in case of the apterous females are usually reddish here, but may be dusky, the darkest color coming next to the well defined yellowish or pale orange blotches surrounding the cornicles. The body generally is quite strongly tinged with pink; the dusky specks so conspicuous upon the larvæ are entirely absent, as are all the heavier dark markings of the adult forms.

Alate Viviparous Female—Plate 9, figs. 3 and 6.

Specimens from Delta, Colorado. Sent by Mr. Weldon May 23, 1908.

Head, thorax, antennæ, tarsi, distal ends of femora and tibiæ, sternum of mesothorax, anal plates and coxæ deep shining black; the middle portion of the dorsum of segments 3, 4 and 5 and transverse bands on segments 6, 7, and 8, small spots and dashes upon joints 1 and 2 and the lateral margins of joints 2 to 7 also black or blackish; abdomen light olive to yellowish green; cornicles short, cylindrical or somewhat tapering, dark green to black in color and with moderate flange; cauda of moderate length, green at the base, black about the margins, upturned; lateral tubercles of prothorax moderate in size; strong tubercles upon lateral margins of abdominal segments 3 to 7, helping to make the margins of the segments prominent and well defined; length of body 1.75 mm.; width .75 mm.; length of antenna 1.12 mm.; joints: III, .30; IV, .19; V, .16; VI, .10; VII, .30 mm.; length of wing 2.50 to 3 mm.; hind tibiæ, .90 mm.; cauda, .11 mm.; cornicles, .11 mm.; third joint of antenna strongly tuberculate on inferior surface with about 24 circular and oval sensoria; joint 4 with about 6 sensoria in middle portion; joints 3 to 7 quite strongly transversely wrinkled; wing venation normal; 2nd fork about equally distant from 1st fork and the margin of the wing.

Apterous Oviparous Female—Plate 9, fig. 4.

Specimens taken by Mr. Geo. P. Weldon at Delta, Colo., October 26, 1908, on leaves of apple trees.

The general color varies from a dull green to bright pink or even dark salmon, with the numerous minute dusky spots characteristic of this species. The dorsal surface is more or less mottled in many of the specimens due to the ova which show through. The head is noticeably dusky brown in color; anal plates and a transverse dash on the eighth abdominal segment, the tarsi, distal ends of the tibiæ, eyes, and distal half of the antennæ black or blackish; antenna 6 or 7-jointed; cornicles slightly dusky; color beneath about the same as above except that it is a little lighter; length of body 1.35 mm.; antenna, .51 mm.: joints: III, .10; IV, .07; V, .08; VI, .07; VII, .12 mm.; no sensoria on antenna except the usual ones at the distal ends of joints 5 and 6 (or 4 and 5 in those that are 6-jointed). When there are but 6 joints, joints 3 and 4 are united.

Winged Male.

Specimens from red clover, Ft. Collins, November 2, 1906.

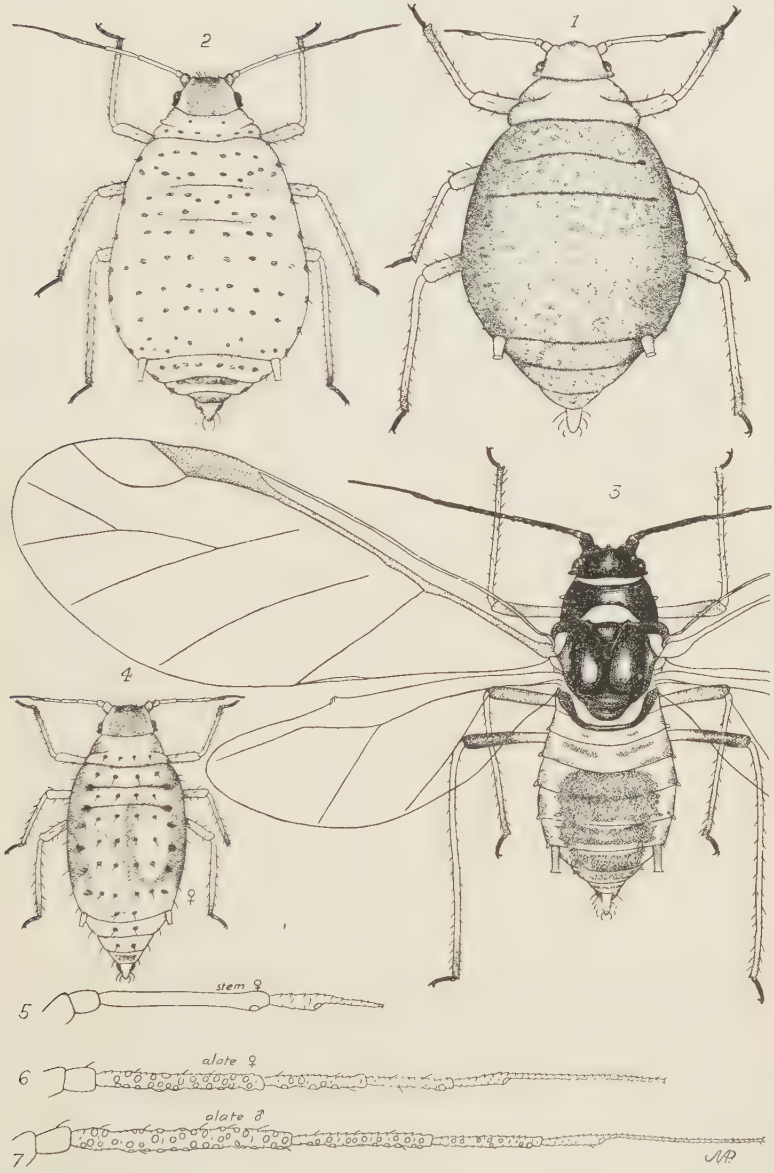
The general color is light yellowish brown; head, thorax, cornicles, antennæ, distal end of beak, coxæ, tarsi, distal ends of femora and tibiæ, eyes, mesothorax below and a large spot on either side of the mesopleurum black; style, anal plates, a row of spots on the lateral margins of abdomen, about six transverse dashes on the abdominal segments above, dusky brown to black; length of body about 1.70 mm.; length of wing 2.20 mm.; length of antennæ 1.40 mm.; joints of antennæ as follows: I and II, .11 mm.; III, .41 mm.; IV, .26 mm.; V, .21 mm.; VI, .12 mm and VII, .29 mm; style .10 mm.; cornicles .07 mm. The cornicles are cylindrical in form and are about twice as long as broad; joints three, four and five of the antennæ strongly tuberculate, with numerous circular sensoria; on joint III about 30 to 40; IV, 15 to 18; V, 8 to 10; Plate 9, fig. 7.

EXPLANATION OF PLATE

Plate 9.—*Aphis bakeri;* 1, stem-mother; 2, apterous viviparous female; 3, alate female; 4, oviparous female; 5, the 5-jointed antenna of the stem-mother; 6, antenna of alate viviparous female; 7, antenna of male. Figures 1, 2, 3 and 4 are enlarged 30 diameters; figures 5, 6 and 7, 80 diameters; M. A. Palmer, artist.

Figures 3 and 5 were used in Bulletin 133 of the Colo. Exp. Sta.

Errata: On plate 6, figure 4, for alate read *apterous.*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DIMPLES IN APPLES FROM OVIPOSITION OF LYGUS PRATENSIS L.

By Estes P. Taylor, *Mountain Grove, Missouri*

To one conducting experiments against insect pests infesting fruits it is especially important that the cause of all external blemishes upon the fruits be known. Failure to recognize the cause of such injuries has often been responsible for misleading and incorrect conclusions regarding the effectiveness of insecticidal sprays. Mistaken identification of insect work is often brought about by superficial examination of fruit at picking. At this time the growth of the fruit has often so completely altered the appearance of the injury that its true cause is never suspected.

Careful and almost continuous observations in an apple orchard this season from the time of the formation of the fruit to harvest resulted in the discovery that an injury of doubtful nature but resembling and formerly classed as that caused by the plum or the apple curculio was, instead, the result of egg punctures made in the very early development of the apple by the common tarnished plant-bug (*Lygus pratensis* L.). On account of their direct bearing upon the examinations of apples by those conducting spraying experiments in the control of curculio upon apple, the results of these observations are herein reported. The observations also add new information upon the egg-laying habits of the tarnished plant-bug, one of the oldest recorded insects in North America.

Late in March at Mountain Grove, Missouri, my attention was called to the great abundance of the tarnished plant-bugs about the buds and newly opened blossoms of early blooming varieties of peach. They were noted in great numbers about the blossoms of peaches in the station orchard by the director of the station, while engaged in hand pollinating blossoms. Many blossoms were seen at this time which had evidently been blasted by this insect having pierced the tissue and sucked away the juices of the essential organs of the bloom. A very noticeable percentage of the blossoms were noted at that time darkened and shrunken and falling away, evidently from this cause. At Olden, on March 27, I noticed numbers of the bugs about the buds of peach, plum, apple and pears, and in making jarrings for curculio under peach and plum trees a number of the bugs were collected upon the jarring sheet. On April 10, while examining with an assistant, Mr. C. B. Dull, fruit buds in an apple orchard selected for a spraying experiment with curculio and codling-moth, small dark-colored spots were noticed upon the sides of the ovary of the apple bloom. These

spots were first noticed upon apples of the Blue Pearmain variety, which had only within the past two or three days completed the shedding of the petals, and upon none of which were the calyces closed. At first the spots were taken as the first evidences of apple scab. A closer inspection suggested the feeding punctures of the plum curculio. Examining the spots under a hand lens I discovered to my surprise that in the center of the discolored area there was a distinct opening in the skin of the apple and that within this opening and just beneath the surface was an oval, elongate, bottle-shaped egg. At first I did not recognize the egg as any with which I was familiar. The abundance of the tarnished plant bug upon the blossoms of the different orchard trees mentioned suggested their association with the eggs found, which was substantiated a moment later by the capture on these trees of gravid female specimens of *Lygus pratensis*, from which eggs were dissected. These eggs corresponded perfectly with the ones found deposited within the minute apples. By dissection two females yielded fourteen well defined eggs each. To further substantiate the observation a large number of the newly formed apples, containing what appeared to be freshly deposited eggs, were confined in a breeding cage in the insectary. Hatching began eight days later, yielding the young of this plant-bug. These were kept alive in the cage until they had entered the second or third instar, in which they demonstrated plainly the characteristic markings upon thorax and body, distinguishing this species from related ones. Besides the apples cut open in examination for eggs and those reserved for breeding cages, a considerable number of small apples were picked at random from two or three Blue Pearmain trees on April 10 and examined in the laboratory with the following results:

Number of apples examined	110
Number eggs found	65
Number feeding punctures	11
Apples bearing eggs	45

In this case it will be seen that about 40 per cent of the apples bore egg punctures of this insect. The average number of eggs per apple in infested apples was 1.44. One small apple was found containing four punctures with eggs, four contained three eggs each and nine apples bore two eggs apiece. The eggs measured upon an average .782 mm. in length by .241 mm. in diameter at their widest point. They were smooth and slightly curved, with the end deepest in the tissue bluntly rounded. The end of the egg nearest the surface was truncate and slightly compressed and bore around the margin a white tubular fringe, finely striated. The color was very pale yellow.

The eggs were found laid singly in the fruit, though where very small apples contained several the distance between them was often very small. Sometimes two or three would be found arranged in a row, not more than one millimeter apart, but each egg occupying a separate and distinct incision. The usual rule was that of single and scattering egg punctures. The eggs were placed on end or at right angles with the surface of the apples, snugly fitting into the incisions made for them. These incisions when made in the sides of the ovaries of blossoms which had but recently shed their petals were of depth sufficient to pierce the carpel walls. In one instance an egg was found in an incision made within the stem of the miniature apple. Out of thirty-six egg incisions counted, fifteen were in the third nearest the tip or calyx end, thirteen were in the middle third, and eight were made in the third nearest the stem. The eggs are deposited in the apple usually with the outer end just beneath the surface of the skin. Quite often the growth of the tissue of the apple forces the eggs outward lengthwise and they may often be seen with their whitish truncate tube-like ends extruded into view as much as one third or one half the length of the eggs. It is not altogether unlikely that this may be in some cases due to shallow egg laying by the female. When not extruded in this manner they are difficult to discern, as the heavy pubescence over the minute apples conceals them. Freshly laid eggs are more difficult to discern since the tissue surrounding has not become discolored.

Eggs are laid sometimes before the petals fall from the blossom and probably some are deposited while still in the bud. No freshly laid eggs were found in any case after the apples were more than one third of an inch in diameter, and usually not later than the time of the closing of the calyx. The past spring the early blooming varieties suffered more heavily than those opening later. Though eggs were hatching from Blue Pearmain on April 18 the eggs laid in late blooming Ingram were found hatching in the orchard May 1. The adults became more scarce upon fruit trees after the dropping of the petals, although some were seen resting upon the fruit of peaches, when they measured over an inch in diameter. Although the insect is reported as one with two or three generations in Missouri, no egg laying was observed in the apples at any time through the summer.

To determine the effect of the egg-laying upon the development of the fruit a close watch was kept of marked apples known to have had the egg puncture of this insect made upon them. It seemed apparent that the injury probably caused the dropping of some of the small apples soon after setting. By far the larger percentage of affected

apples, however, had their growth arrested at the point of egg laying, which with the growing of surrounding tissue brought about the formation of small, funnel-shaped pits upon the surface about each egg incision. Upon the 14th of May, while the Ingram apples were still small and covered with a fuzzy pubescence, 31 fruits which bore 36 unmistakable egg pits from the tarnished plant-bug were carefully marked upon the trees. These were observed from time to time and development of the egg-pits noted up to the time of the full maturity of the fruit, which was harvested October 6. Although, as stated, the variety did not seem so heavily infested as some of the earlier blooming ones, a count of 2,189 apples picked from nine small trees showed about 3 per cent with well defined cavities upon their surface due to this cause. Some apples bore as many as five egg-pits each. Measurements of twenty-one cavities upon apples varying from two to three inches in diameter gave an average distance across the top of the depression of .49 inch, with a variation of from .30 to .75 inch. From the surface the sides of the cavity sloped gradually to the bottom, forming an inverted cone-shaped depression with an average depth of .17 inch and a variation of from .08 to .35 inch. Leading inward into the apple from the bottom of the cavity is a greenish, pithy tissue, which extends in a straight line toward the core, sometimes terminating within and sometimes just outside the carpel walls. If the injury has been near the stem or calyx end of the apple the threadlike canal may reach the core above or below the poles of the carpels. This hardened tissue is sometimes of a tubular form, having an average diameter of about .02 inch. It is sometimes open but is for the most part filled with a loose, brown, cellular tissue. It is the outgrowth of the original cavity in which the eggs were laid and in one instance what appeared to be an empty egg-shell was dissected from the base of one of these egg-pits in a matured apple on October 31, fully six months from the date of oviposition, the observation affording still further and convincing proof of the cause of the injuries noted. The egg-pits must be considered of some economic importance to the fruit grower but they do not seriously affect the keeping quality of the fruit and, except in cases which cause serious distortion of the fruit, does not lower its grade.

That injuries in apples due to the oviposition of the tarnished plant-bug may be expected in any portion of the United States where this fruit is grown is probable, since this insect is widely distributed. Such an omnivorous feeder may be expected to be present and ready for oviposition in apples in the spring in almost any quarter. The typical egg-pits of this insect were noted the past season, more or less,

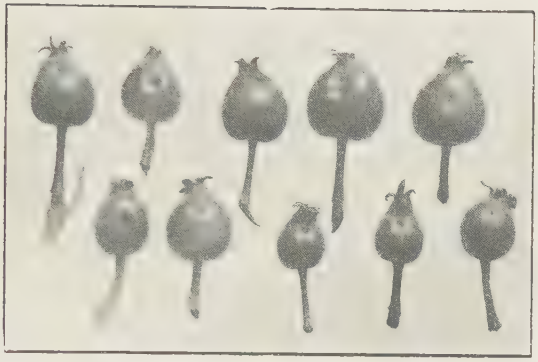
in all fruit districts visited in Missouri. It is known to occur over the United States, from the sea-coast to above timber-line on the highest mountains of the Rockies in Colorado. It ranges south into Mexico and north far into Canada. It is one of the well known insects of Europe, having first been described by Linnaeus in 1767 and again under another name by Palisot de Beauvois in France from insects collected in Africa and America. It was first brought to the notice of American entomologists by Thomas Say in 1831 and mentioned as an injurious insect by Harris in 1841. It is mentioned as an economic pest by Riley, Walsh, LeBaron, Cooke, Glover, Saunders and Lugger and has at some time or other been included in the reports of nearly every leading entomologist in the country.

So far as the writer is aware this record is the first of oviposition of the insect in apples, or in fact in any fruit. Professor Woodworth states that the egg of this insect was not known at all until 1884 when Doctor Forbes, after a protracted search, succeeded in finding a single specimen among the hairs of the petiole of a dead strawberry leaf, and Professor Slingerland is reported to have found their eggs in blighted peach twigs in New York.

It was no small satisfaction to the writer to be able to accurately identify these egg-pits this fall upon apples in experimental blocks, very successfully treated for the control of curculio and codling-moth. Without this knowledge I should have been led to classify the injuries as the very early food punctures of the apple curculio (*Anthonomus quadrigibbus* Say), or even the early food punctures of the plum curculio (*Conotrachelus nenuphar* Hbst.). It seems possible that failures, or at least only partial successful results, which have been reported in the control of curculio upon apples with arsenical sprays, has been due to this mistaken identity of injuries.

Remedies or preventive measures will not be discussed in this article, but it has been observed by the writer that orchards where clean cultivation is practised and where a minimum number of adults are permitted to hibernate through the winter suffer least from spring oviposition in the fruit.

The photographs reproduced herewith show the egg-pits from the tarnished plant-bug in Ingram apples in their various stages of growth. Fig 1, Plate 10, in which the size of the apples is reduced about one half, shows the depressions upon apples when very small, still coated with pubescence and less than a month after the hatching of the plant-bug eggs. Fig. 2, Plate 10, shows apples of about one third size, about two months from egg hatching. These well illustrate the depressions which may be appropriately spoken of as "dim-



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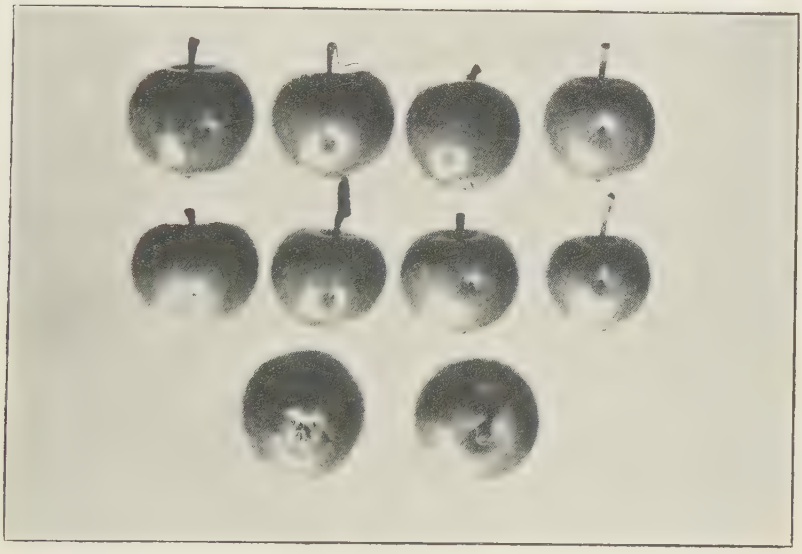
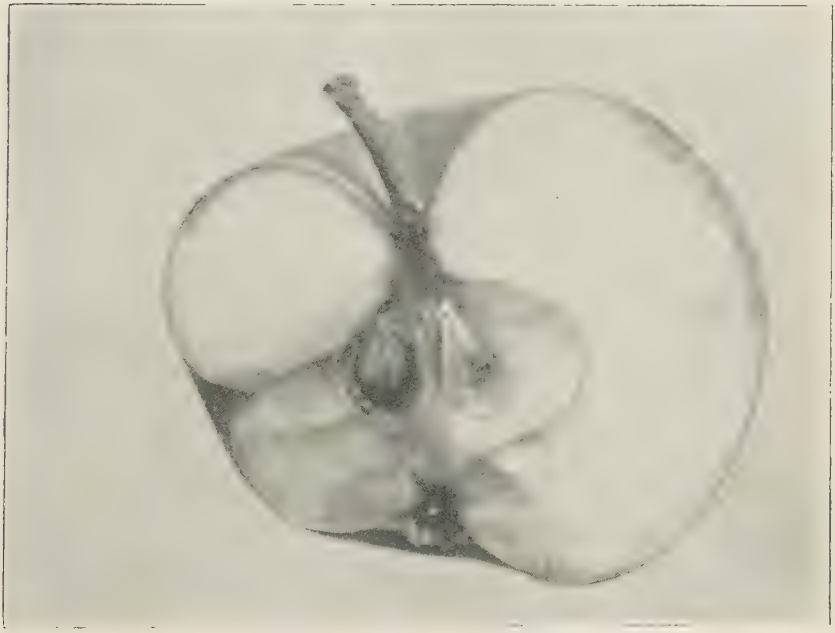


2

Dimples in Apples from Oviposition of the Tarnished Plant Bug

1



2

Dimples in Apples from Oviposition of the Tarnished Plant Bug

ples." Fig. 1, Plate 11, was taken about two months from the hatching of the plant-bug egg and shows apples and dimples about natural size. One of the apples exhibits two dimples on the surface shown. In Fig. 2, Plate 11, is shown an Ingram apple about natural size in longitudinal section, with the depression and pithy tube, the outgrowth of the egg incision, extending nearly to the core. The axis of the apple is twisted, resembling distortions from other insect injuries. This photograph was taken at harvest time, about five months from the hatching of the egg of the tarnished plant-bug.

NOTES ON THE GRASS MITE, PEDICULOPSIS GRAMINUM REUTER

H. E. Hodgkiss, *Geneva, N. Y.*

This species belongs to the Tarsonemidæ, which is a small family of the order Acarina. The mite was first described in 1900 by Dr. Enzio Reuter,[1] from specimens taken from grass in Finland, and was placed by him in the genus *Pediculoides* under the specific name *graminum*. Doctor Reuter afterwards recognized characters of generic significance in this species and thereupon erected the genus *Pediculopsis*, naming *graminum* as the type.[2]

The importance of the species was first indicated by Doctor Reuter in a publication entitled "*Über die Weissährigkeit der Wiesengräser in Finland.*"[1] In Bank's list of the Acarina of the United States[3] no mention is made of this mite, and its identity in this country appears not to have been determined until the present time.

In 1905 Dr. R. H. Wolcott mentioned the appearance of a mite in carnation buds.[4] During the following year the presence of a mite was noted in carnation buds grown on Long Island, and in 1907 it was identified as *Pediculoides graminum* Reuter. In 1908 Heald and Wolcott published an account of the species under the name *Pediculoides dianthophilus*.[5]

Carnation buds infested with the mite were received from Professor Heald, for the purpose of identifying the Nebraska species, which proved to be the same as the one found in New York. That there might be no doubt as to its identity, specimens were sent to Doctor

[1]Acta Societatis pro Fauna et Flora Fennica, 19: N:o 1. 1900.
[2]Festschrift für Palmén, N:o 7, p. 3, footnote 2. Helsingfors. 1907.
[3]Proc. U. S. Nat. Mus., 32: 615.
[4]Science, N. S., 21:389. 1905.
[5]Neb. Sta. Bul. 103. 1908.

Reuter for determination and were pronounced by him to be identical with the species he had described as existing on grasses in Finland. It therefore appears that *P. dianthophilus* Wolcott is a synonym of *P. graminum* Reuter.

Pediculopsis graminum Reuter appears to be a widely distributed species in the United States. It has been taken from carnation buds in Nebraska[1] and in widely separated sections of Illinois.[2] In New York state it is a rather common species upon several grasses, from which it is probably distributed to carnation plants growing in the field and subsequently is introduced into greenhouses.

The work of the mite on grass and on carnations is quite dissimilar. On grass it attacks the succulent stem within the sheath, just above the topmost node. The growth of the stem at this point is checked, causing the partially opened panicles to ripen prematurely and giving rise to the condition known as silver top. The portion of the stem which is attacked gradually shrivels and becomes twisted at or just above the node. During the early spring a decay of the injured portion of the stem is usually found. It always appears when the area attacked is close to the ground, where the presence of moisture is favorable for its growth. This decay is due to a fungus which Prof. F. C. Stewart has determined to be *Sporotrichum poæ* Peck.

On carnation plants the mite does not attack the stem but works into the center of the young buds. Here it introduces the same fungus with which it is associated on grass. Experiments made for the purpose of determining the point of attack indicate that the stamens and pistils are first attacked and later the less tender tissues. The fungus then finds a favorable condition for growth and in a comparatively short time the heart is entirely decayed and filled with mites, while the growth of the buds is checked.

The relation of the mite to the fungus is not entirely clear. It appears, however, that the mite visits healthy carnation buds for the purpose of feeding on the tender tissues of the floral organs. Spores of the fungus are thus introduced into the interior portions of the bud, which eventually cause it to decay. The mites breed in this decaying tissue and the subsequent generations migrate to healthy buds, infecting them with the spores of the fungus.

Probably the mite and its accompanying fungus will rarely be sufficiently destructive to require special methods for their control. To prevent unusual infestations it may be desirable to gather the infested buds and burn them. The elimination of susceptible varieties,

[1]Neb. Sta. Bul. 103. 1908. [2]J. J. Davis, Urbana, Ill.

such as Lawson, Enchantress and Bradt may also prove to be advantageous.

The temperature necessary for successful carnation culture is quite favorable for the development of insects and diseases common to carnation plants. For this reason the future of *Pediculopsis graminum* and the associated fungus, *Sporotrichum poa*, as parasites of the carnation, will be watched with considerable interest.

EXPERIMENTS FOR THE CONTROL OF THE RED SPIDER IN FLORIDA (TETRANYCHUS BIMACULATUS, HARV.)

By H. M. Russell, *Bureau of Entomology, Washington, D. C.*

During the early spring of 1908, it was very dry for weeks in Florida, with little rainfall. Under these conditions red spider injury to truck, general crops, and citrus trees was very noticeable. The writer found a small field of wax beans very badly infested by the red spider, May 16, 1908. Some of the leaves were badly distorted and curled, and discolored by numerous yellow blotches, while others were dried up and lifeless from the work of this insect. The red spider lives on the under side of the leaves, spinning a slight web of delicate threads, under the protection of which it feeds.

About the first of June the rainy season in Florida set in and when the plants were examined about a week later, the red spider had almost disappeared.

Experiments for the control of the red spider were conducted at Orlando, Fla., from May 22, until June 1, 1908, the results of which are summarized below.

Experiment No. 1.—May 22, 1908. Lime-sulphur (at the rate of 1 pound of lime and 1 pound of sulphur to 25 gallons of water,[1] *a*) was sprayed on a row of wax beans, using an underspray. This was at 5.30 p. m., the sky being cloudy, and a fair breeze blowing. On May 28, a number of leaves of sprayed plants were examined as were leaves of unsprayed plants also (for the purpose of checking), with the following results:

[1] In Circ. 65, U. S. Dept. of Agriculture, Bur. Ent., Prof. E. S. G. Titus states that the heat generated by slaking lime will dissolve the sulphur. The writer finds that, when made up in small lots, it is necessary to boil the two ingredients together as enough heat is not generated to dissolve the sulphur.

TABLE FOR FORMULA *a*

No. of leaf	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Live red spiders on leaves sprayed	3	7	1	100	7	1	1	1	0	10	8	7	2	2	16	1
Live red spiders on unsprayed leaf	80	78	39	36	37	36	12	55	2	59	60	26	0	3	5	5

Total number red spiders left on plants sprayed, 167 (1).
Total number red spiders left on plants unsprayed, 533.

The above figures show a total of 76 per cent killed by the one spraying; the plants showing no injury from the spray.

Experiment No. 2.—May 28, 1908. Lye-sulphur (1 pound sulphur and ½ pound of lye to 40 gallons of water, *c*) was sprayed on a row of wax beans, using an underspray. The spray was applied at 10.15 a. m., the day being cloudy and there being a fair breeze. On May 30, 1908, an examination was made of a number of sprayed leaves and checks, the results of which are as follows:

TABLE FOR FORMULA *c*

No. of leaf	1	2	3	4	5	6	7	8	9	10	11	12	Total
Live red spiders on leaves sprayed	0	1	1	0	0	0	0	0	3	0	0	0	5
Live red spiders on unsprayed leaf	1	77	74	6	17	39	3	8	37	11	1	1	275

This count gives 98.4 per cent killed by the one spraying, and seems a very high percentage to the writer. The plants show no injury resulting from the spraying.

Experiment No. 3.—May 28, 1908. Sulphur (1 ounce to 1 gallon of water, *d*) was sprayed on a row of wax beans, using the underspray. The spraying was done at 11 a. m., the sun shining brightly and there being a fair breeze. On May 30, a number of sprayed leaves and checks were examined with the following results:

TABLE FOR FORMULA *d*

No. of leaf	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Live red spiders on leaves sprayed	0	1	1	0	1	0	1	1	4	?	0	0	0	0	1=10
Live red spiders on unsprayed leaf	5	3	3	1	4	17	2	8	10	?	4	22	11	10	5=110

[1] Of the sprayed leaves, one examined had 100 red spiders upon it and, it seems to the writer, that a truer result would be obtained by ignoring this one leaf and its check.

This count gives 91.7 per cent killed by this spraying. Plants show no signs of damage from spraying. On the date of this examination the sulphur was found still adhering to the beans in small particles.

(*c*) In making this spray the lye should be finely pulverized.

(*d*) In making this spray the sulphur should be made into a thin paste with a small amount of water, after which the balance of the water is added.

Experiment No. 4.—May 29, 1908. Kerosene-soap emulsion (1 part of the stock solution to 10 parts of water, *e*) was sprayed on a row of wax beans, using an underspray.

This was applied at 10.30 a. m. with a bright sun and a good breeze. On May 30 a number of sprayed plants and checks were examined with the following results:

TABLE FOR FORMULA *e*

No. of leaf	1	2	3	4	5	6	7	8	9	10	11	12	Total
Live red spiders on leaves sprayed..	1	0	0	0	2	0	0	1	1	0	0	0	5
Live red spiders on unsprayed leaf..	5	3	3	1	4	17	28	10	5	4	22	11	113

This count gives a total of 95 per cent killed by this spray. The plants show a few leaves with burned edges, but in no case seriously.

(*e*) This stock was made up four weeks previous to using, and the writer finds a small amount of free oil.

SUMMARY OF EXPERIMENTS IN SPRAYING FOR THE RED SPIDER

No. of Expt.	Date.	Insecticide.	Effect on Red Spider.	Effect on Plant.
1	May 28	Lime-sulphur	Killed 68 to 85%	None.
2	May 28	Lye-sulphur	Killed 98%	None.
3	May 28	Sulphur-water	Killed 91%	None.
4	May 29	Kerosene emulsion	Killed 95%	Slight.

Conclusion

The results of these experiments show that this pest can be controlled by spraying with any of these four insecticides; but because of the difficulty experienced in making the kerosene emulsion, as compared with the other three, it is not likely to be employed, at least in Florida.

At the same time that these experiments were conducted, observations were made on the effect of rain on the red spider. On the 27th

and the 30th of May it rained very hard, and on June 2d a check row of beans was examined and 207 red spiders were found on 13 leaves.

On June 8th, after a week of daily rain, very few red spiders were to be seen. From this it appears that one or two rains will not seriously injure the red spider, but that continued rains for several days are fatal to a large proportion of the insects.

A LIST OF PARASITES KNOWN TO ATTACK AMERICAN RHYNCHOPHORA

By W. Dwight Pierce, *Bureau of Entomology, U. S. Dept. of Agriculture*

As the weevils become more important economically there will be a growing necessity of understanding the parasites which may check their injuries. A preliminary list of these parasites was published by the writer in Bulletin 73 of the Bureau of Entomology, without, however, indicating the sources of the records. Since that time many other important records have been added, and if all the species bred by the boll weevil investigation force were determined, double the number of additions could be included.

The credit for parasite breeding records made at the boll weevil laboratory during 1907 and 1908 must be shared equally by the writer with Messrs. R. A. Cushman and C. E. Hood.

Notice of omissions is very earnestly requested.

Fungi.

Aspergillus sp. is recorded by Hunter and Hinds (1904. 105) as bred from *Anthonomus grandis* Boh., at Victoria, Texas.

Cordyceps sp. was found attacking the boll weevil (*Anthonomus grandis*) at San Juan Allende, Mexico (Townsend 1895a).

Empusa (*Entomophthora*) *sphaerosperma* attacks the clover-leaf weevil, *Phytonomus punctatus* Fab., abundantly at Annapolis Junction, Md. (Johnson 1898).

Entomophthora phytonomi attacks the same weevil in Ontario (Fletcher 1900).

Isaria tomicii Lugger is recorded as killing adult *Platypus compositus* Say (Hopkins 1896).

Sporotrichum globuliferum was bred from the imbricated snout beetle, *Epicaerus imbricatus* Say, by Chittenden (1900b. 31).

Acarina.

Tarsonemidae.

Pediculoides sp. (nec. *ventricosus* Newp. mis-spelled *ventriculosus*) is a common parasite of *Anthonomus grandis* Boh. (Rangel 1901a, b) and

Anthonomus eugenii Cano, the pepper weevil, (Meraz 1905), in Mexico, and is used by the boll weevil investigation in Texas.

Pediculoides sp. nov. is a parasite first discovered in the Dallas laboratory attacking *Trichobaris compacta* Casey and *Anthonomus grandis* Boh. It was later found to attack any insect within its reach.

Pediculoides sp. is recorded from *Laria* (*Bruchus*) *chinensis* Linn. by Chittenden (1899. 245) under the name of *Pediculoides ventricosus* Newm. (The genus *Bruchus* Linn. 1767 is a synonym of *Laria* Scop. 1763 according to Ganglbauer (1903. 308).

Tyroglyphidae.

Tyroglyphus breviceps Banks (1906) was described as a parasite of *Anthonomus grandis*.

Diptera. Cyclorrhapha.

Phoridae.

Aphiochaeta nigriceps Loew. (det. by Coquillett) was bred September 26, 1906, from "a very small parasite larva on small weevil larva" isolated from dry hanging bolls collected September 12th at Dallas, Texas. The puparium, larval skin and remains of the weevil larva in the breeding tube were the proofs of primary parasitism.

Aphiochaeta fasciata Fallen (?) (det. by Coquillett)
Aphiochaeta pygmaea Zett. (det. by Coquillett)
} On October 6, 1906, a weevil larva was isolated from hanging bolls collected at Dallas, Texas, with this note: "Weevil larva full of Dipterous larvae." Eleven larvae left this host and pupated. On October 29, seven of the first species and two of the latter were bred.

Tachinidae.

Metadexia basalis G. T. (det. by Coquillett) is contained in the U. S. National Museum as a parasite of *Conotrachelus juglandis* Lec. from West Virginia.

Cholomyia inaequipes Bigot (det. by Townsend) is contained in the U. S. National Museum as a probable parasite of *Conotrachelus nenuphar* Hbst. in Missouri, and as bred from *Conotrachelus juglandis* Lec., taken at Mounds, Louisiana, August 30, 1897 (U. S. D. A. 7662[01]). This species was bred May 29, 1907, from *Conotrachelus elegans* Boh. at Dallas, Texas.

Myiophasia aenea Wied. (det. by Coquillett) is a parasite of *Balaninus nasicus* Say, *Conotrachelus juglandis* Lec., *Sphenophorus parvulus* Gyll. (Coquillett 1897); *Ampeloglypter sesostris* Lec. (Webster); *Anthonomus grandis* Boh. (Pierce 1907b. 269, 1908a. 40); *Conotrachelus affinis* Boh. (Pierce 1907b. 274). It is a common parasite of *Conotrachelus elegans* Boh. The Sphenophorus record is based on *Phasioclista metallica* Towns., supposed to be a synonym of *M. aenea* Wied.

Myiophasia robusta Coq. is a parasite of *Sphenophorus robustus* Horn (Coquillett 1897).

Myiophasia setigera Towns. type, was collected ovipositing in an acorn of *Quercus alba* at Ruston, La., October 31, 1907, by the writer.

Ennyomma clistoides Towns. (according to Mr. Townsend this species is distinct from *Myiophasia aenea* Wied.) is a parasite of *Chalcodermus aeneus* Boh. (Howard 1894. 280; Chittenden 1904. 43).

Ennyomma [*Loewia*] *globosa* Towns. (according to Mr. Townsend this species also is distinct from *Myiophasia aenea* Wied.) was bred from the boll weevil, *Anthonomus grandis* by C. R. Jones throughout the fall of 1907 at Alexandria, La.

Lixophaga parva Towns. type, was bred August 15, 1907, at Dallas, Texas, from *Lixus scrobicollis* Boh. The weevil skin was attached to the outside of the puparium.

Hymenoptera. Vespoidea.

Bethylidae. Bethylini.

Cephalonomia hyalinipennis Ashm. is recorded as possibly a parasite of *Hypothenemus eruditus* Westw. (Chittenden 1893b. 250; Ashmead 1893a. 49, 451). This record is open to doubt.

Hymenoptera. Proctotrypoidea.

Platygasteridae. Platygasterinae.

Trichacis rufipes Ashm. is possibly a parasite of *Balaninus nasicus* Say (Ashmead 1893a. 296, 451). This record is open to doubt.

Hymenoptera. Chalcidoidea.

Torymidae. Monodontomerinae.

Microdontomerus anthonomi Cwfd. attacks *Anthonomus grandis* Boh. and *Anthribus* [*Brachytarsus*] *alternatus* Say (Crawford 1907a. 133; 1907b. 179), being very abundant in central Texas on the boll weevil. (Brachytarsus Sch. 1833=Anthribus Forst. 1771 according to Ganglbauer 1903. 311). This parasite was also bred in both sexes at Dallas, Texas, from *Laria* [*Bruchus*] *exigua* Horn.

Chalcididae. Chalcidinae. Smicrini.

Spilochalcis sp. A single male of this species was found dead in a weevil cell with the remains of the weevil and its own exuvium in a hanging square collected August 10, 1907, at Victoria, Texas.

Eurytomidae. Eurytomini.

Eurytoma magdalidis Ashm. was described as parasitic on *Magdalis armicollis* Say (Ashmead, 1896a. 326).

Eurytoma tylodermatis Ashm. was described as parasitic on *Tyloderma foveolatum* Say (Ashmead 1896a. 218). It is parasitic on *Lixus musculus* Say, and *Anthonomus squamosus* Lec. (Pierce 1907a; b; c; 1908a); on *Orthoris crotchii* Lec. (Pierce 1907b; 1908a); on *Anthonomus heterothecae* Pierce (nec. *disjunctus* Lec.) (Pierce 1907a; b; 1908a; d); on *Anthonomus grandis* Boh. (Hunter and Hinds 1904; 1905; Pierce 1907b; 1908a; c); on *Apion scgnipes* Say (Chittenden 1908. 31). It was bred abundantly from the typical Laria in *Vachellia farnesiana* taken at Victoria, Texas; from *Spermophagus robiniae* Sch. collected at Shreveport, La.; from *Lixus scrobicollis* at Dallas, Texas; and from *Trichobaris texana* Lec. at Cisco and Dallas, Texas; and was

also bred from typical *Macrorhoptus sphaeralciae* Pierce collected at Del Rio, Texas. *Bruchophagus herrerae* Ashm. described from *Anthonomus grandis* is a synonym of this species, according to J. C. Crawford.

Bruchophagus mexicanus Ashm. was bred in Arizona from *Laria* [*Bruchus*] *alboscutellatus* Horn and *L.* sp. (Townsend 1895b).

Perilampidae.

Perilampus sp. A single individual was bred from the boll weevil, *Anthonomus grandis*, in an isolated weevil cell, by C. E. Hood, from squares collected September 7, 1907, at Shreveport, La.

Cleonymidae. Cleonyminae.

Cheiropachys colon Linn. attacks *Magdalis aenescens* Lec. (Chittenden 1900a. 37, 43) and *Eccoptogaster* [*Scolytus*] *rugulosus* Ratz (Howard 1888).

Encyrtidae. Eupelminae. Eupelmini.

Cerambycobius brevicauda Cwfd. was described as a parasite of *Laria exigua* Horn, bred at Dallas, Texas (Crawford 1908. 158).

Cerambycobius bruchivorus Cwfd. was described as a parasite of the typical Laria in *Vachellia farnesiana* from Victoria, Texas, bred at Dallas, (Crawford 1908. 158).

Cerambycobius cushmani Cwfd. was described as a parasite of *Anthonomus grandis* from Victoria, Texas (Crawford 1908. 158) at which place it has deflected in large numbers from its original host, the typical Laria in *Vachellia farnesiana*, due to the failure of that plant to fruit. It was also bred as parasite of the boll weevil at Hallettsville, Goliad, and Brownsville, Texas, and Alexandria, La., and from *Araecerus fasciculatus* Woll. at Victoria, Texas.

Cerambycobius cyaniceps Ashm. is a very common parasite of *Anthonomus grandis* throughout Texas and Louisiana (Mally 1902; Pierce 1907b; 1908a, c). It is also a parasite of *Tyloderma foveolatum* Say (Pierce 1908a), *Laria exigua* Horn (Chittenden 1893b), *Lixus musculus* Say, *Anthonomus albopilosus* Dietz (Pierce 1907b, c; 1908a), *Trichobaris texana* Lec. (Pierce 1907b; 1908a), *Laria obtecta* Say (Chittenden 1899. 242). It was an abundant parasite of *Laria exigua* Horn collected at Dallas; was bred from the huisache (Vachellia) Laria collected at Victoria; from *Spermophagus robiniae* Sch. and *Lixus scrobicollis* Boh. at Alexandria, La.; from fruit of *Crataegus mollis* at Victoria, Texas, infested by *Tachypterellus quadrigibbus* Say and *Conotrachelus crataegi* Walsh; from *Trichobaris compacta* Casey collected at Paris, Texas; from Baptisia pods infested by *Tychius sordidus* Lec.; and was also bred at Washington by J. A. Hyslop from *Apion rostrum* Say.

Tanaostigmodes tychii Ashm. was described from *Tychius semisquamosus* Lec. (Ashmead 1896. 20).

Encyrtidae. Eupelminae. Tanaostigmini.

Eutrichosoma albipes Cwfd. was described from *Auleutes tenuipes* Lec. upon which it breeds abundantly at Dallas, and from *Smicronyx tychoides* Lec. upon which it is very abundant at Victoria (Crawford 1908. 158).

Pteromalidae. Pteromalinae. Metaponini.

Bruchobius laticollis Ashm. attacks *Laria obtecta* Say (Chittenden 1899. 242) and *Laria pisorum* L. (Pierce 1908. 42).

Pteromalidae. Pteromalinae. Rhaphitelini.

Rhaphiteles [*Storthygocerus*] sp. was bred from *Magdalis armicollis* Say (Hubbard 1874).

Rhaphiteles maculatus Walk. is recorded from *Eccoptogaster* [*Scolytus*] *rugulosus* Ratz (Howard 1888).

Dinotus sp. attacks *Magdalis aenescens* Lec. (Chittenden 1900a. 42).

Habrocytus rhodobaeni Ashm. was described from *Rhodobaenus tredecimpunctatus* Ill. (Ashmead 1896a. 220; Howard 1900. 105).

Pteromalidae. Pteromalinae. Pteromalini.

Meraporus calandrae How. attacks *Calandra oryzae* Linn. as well as *Sitodrepa panicea* Linn. (Howard, Comstock 1881. 273; Chittenden 1897. 43–45).

Meraporus bruchivorus Ashm. was described as a parasite of *Laria exigua* (Ashmead 1893. 161).

Meraporus n. sp. has been bred from *Calandra oryzae* by E. S. Tucker at Plano, Texas.

Catolaccus anthonomi Ashm. was described from *Anthonomus signatus* Say (Chittenden 1893a. 185) and also bred from *Anthonomus nigrinus* Boh. (Chittenden 1895. 351). A species closely resembling this attacks *Anthonomus grandis* in the fall at Waco and Dallas, Texas.

Catolaccus coeliodis Ashm. was described from *Acanthoscelis* [*Coeliodes*] *acephalus* Say (Ashmead 1896. 227).

Catolaccus hunteri Cwfd. was described from *Anthonomus grandis* Boh. at Mineola and Waco, Texas (Crawford 1908. 160), and has also been bred in many other parts of southwestern Texas. It is a parasite of *Anthonomus albopilosus* Dietz in south Texas, *A. eugenii* Cano, the pepper weevil, *A. squamosus* Lec. at Clarendon, Texas, *A. signatus* Say from dewberries in south Texas, *A. aeneolus* Dietz throughout central and west Texas, *A. heterothecae* Pierce at Jacksonville, Texas, *Tachypterellus quadrigibbus* Say at Victoria, Texas, and *Zygobaris xanthoxyli* Pierce at Runge and Beeville, Texas. It was formerly confused with the following species.

Catolaccus incertus Ashm. was described from *Anthonomus signatus* Say (Chittenden 1893a. 1896). Since this species has in the past been confused with the preceding species only the following records may be credited to it; *Anthonomus nigrinus* Boh. (Chittenden 1895. 351), *Apion decoloratum* Sm., *Apion griseum* Sm. (Chittenden 1908. 30, 32), *Laria exigua* Lec. (Pierce 1908. 37). It also attacks *Anthonomus grandis* Boh. mainly in east Texas and Louisiana, *A. albopilosus* Dietz in Louisiana, *A. aphanostephi* Pierce, *A. fulvus* Lec. and *Auleutes tenuipes* Lec. in Texas.

Neocatolaccus tylodermae Ashm. was described from *Tyloderma foveolatum* Say (Ashmead 1893. 161), and is also recorded from *Ampeloglypter sesostris* Lec. (Webster 1900), *Lixus musculus* Say (Pierce 1907,

1908), *Lixus mucidus* Lec. (Pierce 1907, 260) and *Lixus parcus* Lec. (Pierce 1908. 43).

Pteromalidae. Spalangiinae.

Cerocephala elegans Westw. is a parasite of *Calandra oryzae* Linn. and also of *Sitodrepa panicea* Linn. (Chittenden, 1897. 44).

Cerocephala pityophthori Ashm. attacks *Pityophthorus consimilis* Lec. (Riley and Howard 1891. IV. 123).

Cerocephala scolytivora Ashm. is parasitic on *Loganius ficus* Schwarz (Riley and Howard 1891. IV. 122).

Eulophidae. Entedoninae. Omphalini.

Omphale elongatus Ashm. was bred from *Attelabus rhois* Boh. at Wales, Maine, by C. E. Frost (Psyche 1904).

Omphale livida Ashm. is a parasite of *Ceutorhynchus rapae* Gyll. (Chittenden 1900b. 49).

Eulophidae. Entedoninae. Entedonini.

Horismenus [*Holcopelte*] *popenoi* Ashm. is probably hyperparasitic on *Spermophagus robiniae* through *Coenophanes spermophagi* Ashm. (Wickham 1895).

Horismenus lixivorus Cwfd. is described as parasitic on *Lixus musculus* Say (Crawford 1907b. 180) and has been bred frequently from *Lixus scrobicollis* Boh.

Horismenus [*Holcopelte*] *producta* Ashm. was bred from *Laria* [*Bruchus*] *amica* Horn at Las Cruces, N. M. (Townsend 1895b).

Horismenus sp. have been bred as parasites of various species of Laria.

Asecodes albitarsis Ashm. is a secondary parasite on *Magdalis aenescens* Lec. (Chittenden 1900a. 37).

Secodes phloeotribi Ashm. is a secondary parasite on *Lixus musculus* Ol., *Pityophthorus minutissimus* Zimm. and *Chramesus icoriae* Lec. (Chittenden 1898. 48).

Entedon lithocolletidis Ashm. parasitizes *Anthonomus nigrinus* Boh. (Chittenden 1895. 350).

Eulophidae. Entedoninae. Pediobiini.

Eriglyptus robustus Cwfd. was described from *Anthonomus nigrinus* Boh. (Crawford 1907b. 180).

Eulophidae. Tetrastichinae. Tetrastichini.

Tetrastichus sp. attacks *Orthoris crotchii* Lec. (Pierce 1907, 1908).

Tetrastichus sp. attacks *Bracon nuperus* Cr. the parasite of *Orthoris crotchii* Lec. (Pierce 1907).

Mymaridae. Mymarinae. Anaphini.

Anaphes conotracheli Gir. was described as an egg parasite of *Conotrachelus nenuphar* Hbst. (Girault 1905. 220).

Hymenoptera. Ichneumonoidea.

Ichneumonidae. Cryptinae. Phygadeuonini.

Stiboscopus brooksi Ashm. was described as a parasite of *Craponius inaequalis* Say. (Brooks 1906. 240).

Ichneumonidae. Pimplinae. Pimplini.

Pimpla pterelas Say is recorded as parasitic on *Mononychus vulpeculus* Boh. (Harrington 1891).

Pimpla inquisitor Say is also recorded from the same weevil (Hamilton 1894).

Ephialtes irritator Fabr. has been bred from *Cryptorhynchus lapathi* Linn. (Jülich 1887).

Ichneumonidae. Ophioninae. Porizonini.

Porizon conotracheli Riley is recorded from *Conotrachelus nenuphar* Hbst. (Riley and Howard 1890. III. 156).

Braconidae. Euphorinae.

Cosmophorus hopkinsii Ashm. is recorded from *Polygraphus rufipennis*, and *Pityophthorus* sp. (Hopkins 1899).

Euphorus phloeotribi Ashm. is a parasite of *Phloeotribus frontalis* (Chittenden 1893b. 249).

Braconidae. Helconini.

Helcon ligator Say is parasitic on *Eccoptogaster* [*Scolytus*] *muticus* Say (Hopkins 1892. 259).

Braconidae. Blacinae. Calyptini.

Calyptus tibiator Cr. is a parasite of *Ampeloglypter sesostris* Lec. (Webster 1900) and *Anthonomus signatus* Say (Chittenden 1893a. 181).

Braconidae. Sigalphinae.

Sigalphus canadensis Prov. is recorded as parasitic on *Anthonomus scutellatus* Gyll. (Gillette 1890. 280).

Sigalphus copturi Riley is a parasite of *Podapion gallicola* Riley or its guest *Cylindrocopturus longulus* Lec. (Riley and Howard 1890. II. 353) and also of *Conotrachelus posticatus* Boh. (Pierce 1907b. 275).

Sigalphus curculionis Fitch is the common parasite of *Conotrachelus nenuphar* Hbst. and also attacks *Conotrachelus elegans* Boh. commonly at Dallas and Victoria, Texas. It is recorded from *Anthonomus grandis* Boh. (Hunter and Hinds 1904. 106), *Trichobaris trinotata* Say (Chittenden 1902) and *Conotrachelus juglandis* Lec. (Pierce 1908a. 43). The last record is based on specimens seen in the National Museum.

Sigalphus zygobaridis Cwfd. is typically parasitic upon *Zygobaris xanthoxyli* Pierce (Pierce 1907b. 289).

Sigalphus sp. is recorded from *Chalcodermus aeneus* Boh. (Howard 1894, 280).

Urosigalphus anthonomi Cwfd. was formerly referred to as *U. robustus* Ashm. in accrediting it to the boll weevil (Hunter and Hinds 1904. 107). It is described from *Anthonomus grandis* (Crawford 1907a. 133).

Urosigalphus armatus Ashm. is a parasite of Balaninus (Chittenden 1904. 33). Specimens seen in the National Museum from West Virginia were bred from a Conotrachelus in nuts.

Urosigalphus bruchi Cwfd. was described from *Laria prosopis* Lec. (Crawford 1907b. 181). It also attacks the Laria in *Vachellia farnesiana* pods, and *Spermophagus robiniae* Sch.

Urosigalphus schwarzi Cwfd. was described from the boll weevil, *Anthonomus grandis* in Guatemala (Crawford 1907a. 134).

Braconidae. Cheloninae.

Phanerotoma tibialis Hald. is very doubtfully to be credited as a parasite of *Anthonomus nigrinus* Boh. (Chittenden 1895. 350).

Braconidae. Agathidiinae. Microdini.

Microdus simillimus Cr. is possibly a parasite of *Lixus scrobicollis* Boh. (Hopkins 1892. 259).

Braconidae. Braconinae. Braconini.

Glyptomorpha lixi Ashm. is recorded from *Lixus scrobicollis* Boh. (Hopkins 1892. 256).

Glyptomorpha mavaritus Cr. is recorded from the same weevil in the same reference.

Glyptomorpha novitus Cr. attacks *Lixus musculus* Say (Pierce 1907b. 261).

Glyptomorpha rugator Say is a common parasite of *Lixus concavus* Say (Chittenden 1900b. 61) and *Lixus musculus* Say (Pierce 1907a. 43). It also attacks *Lixus scrobicollis* Boh. (Pierce 1907b. 261).

Vipio belfragei Cr. is parasitic on *Lixus scrobicollis* Boh. (Hopkins 1892. 256).

Melanobracon simplex Cr. attacks *Dendroctonus piceaperda* Hopk. (Currie 1905. 82).

Microbracon nuperus Cr. is parasitic on *Orthoris crotchii* Lec. (Pierce 1907a. 44).

Bracon analcidis Ashm. was described from *Tyloderma fragariae* Riley (Ashmead 1888. 619).

Bracon anthonomi Ashm. was described from *Anthonomus signatus* (Chittenden 1893a. 182).

Bracon mellitor Say the common parasite of *Anthonomus grandis* attacks also *Anthonomus albopilosus* Dietz (Pierce 1907b. 270, 271), *A. eugenii* Cano (Pratt 1907), *A. fulvus* Lec., *A. squamosus* Lec. (Pierce 1907a. 41, 43), *Craponius inaequalis* Say (Brooks 1906. 240), *Desmoris scapalis* Lec. (Pierce 1907b. 263). It has been bred by Fred M. Brooks from *Conotrachelus nenuphar* Hbst. and at Washington and Dallas from *Tyloderma fovcolatum* Say. *Bracon* (*xanthostigma* Cr.) is recorded from *Laria* [*Bruchus*] *fratercula* Horn (Baker 1895).

Bracon pissodis Ashm. parasitizes *Pissodes strobi* Peck (Riley and Howard 1890. 348).

Bracon rhyssemati Ashm. MS. was bred from *Rhyssematus lineaticollis* Say (Pierce 1908a. 44), at Detroit, Mich., July 24, 1889, by F. M. Webster.

Bracon scolytivorus Cr. is a parasite of *Eccoptogaster quadrispinosus* Say (Packard 1890. 295).

Bracon smicronygis Ashm. MS. was bred from *Smicronyx tychoides* Lec. (Riley and Howard 1890. II. 350).

Bracon strobi is mentioned by Hopkins as a parasite of *Tomicus pini* Say (1892. Div. Ent. bul. 37. 120).

Braconidae. Rhogadinae. Rhyssalini.

Rhyssalus pityophthori Ashm. is parasitic on Pityophthorus (Pierce 1908a. 44).

Braconidae. Spathiinae. Hormiini.

Heterospilus [*Caenophanes*] sp. is recorded from *Laria bisignata* Horn (Riley and Howard 1893. 286).

Heterospilus pityophthori Ashm. MS. is a parasite of *Pityophthorus cariniceps* Lec. (Hopkins 1899).

Heterospilus [*Caenophanes*] *spermophagi* Ashm. attacks *Spermophagus robinii* Sch. (Wickham 1895).

Braconidae. Spathiinae. Spathiini.

Spathius abdominalis Riley attacks *Phloeosinus dentatus* Say (Riley and Howard 1890. 350).

Spathius brevicaudus Ashm. MS. is a parasite of *Dryocoetes autographus* Ratz. (Hopkins 1892. 258).

Spathius brunneus Ashm. is probably a parasite of *Eccoptogaster muticus* (Hopkins 1892. 257).

Spathius canadensis Ashm. is recorded from *Dryocoetes autographus* Ratz., *Magdalis olyra* Hbst., *Phloeosinus graniger* Chap., and *Tomicus sp.* (Hopkins 1892. 258).

Spathius clavipennis Ashm. MS. is recorded from *Polygraphus rufipennis* (Hopkins 1892. 257).

Spathius trifasciatus Riley attacks *Eccoptogaster quadrispinosus* Say (Packard 1890. 294).

Spathius unifasciatus Ashm. MS. attacks the same species (Hopkins 1892. 258).

Braconidae. incert. sed.

Lysitermes scolyticida Ashm. MS. is also recorded from *Eccoptogaster quadrispinosus* (Hopkins l. c.).

List of Weevils Parasitized

In order to make the foregoing reference more applicable, the following list has been arranged. The inclusion of the Lariidæ (Bruchidæ) is on account of their close relationship to the Rhynchophorous series. Species of economic importance are given in **bold face type**, and species serving as co-hosts of boll weevil parasites are preceded by an asterisk (*).

Acanthoscelis acephalus Say.....	Catolaccus coeliodis Ashm.
*Ampeloglypter sesostris Lec.....	Myiophasia aenea Wied.
	Neocatolaccus tylodermae Ashm.
	Calyptus tibiator Cr.
*Anthonomus aeneolus Dietz.....	Catolaccus hunteri Cwfd.
*Anthonomus albopilosus Dietz.....	Cerambycobius cyaniceps Ashm.
	Catolaccus hunteri Cwfd.
	Catolaccus incertus Ashm.
	Bracon mellitor Say.
*Anthonomus aphanostephi Pierce.....	Catolaccus incertus Ashm.

*Anthonomus eugenii Cano	Pediculoides sp.
	Catolaccus hunteri Cwfd.
	Bracon mellitor Say.
*Anthonomus fulvus Lec	Catolaccus incertus Ashm.
	Bracon mellitor Say.
Anthonomus grandis Boh	Aspergillus sp.
	Cordyceps sp.
	Pediculoides (2) spp.
	Tyroglyphus breviceps Banks.
	Aphiochaeta nigriceps Loew.
	Aphiochaeta fasciata Fallen
	Aphiochaeta pygmaea Zett.
	Myiophasia aenea Wied.
	Ennyomma globosa Towns.
	Microdontomerus anthonomi Cwfd.
	Spilochalcis sp.
	Eurytoma tylodermatis Ashm.
	(Bruchophagus herrerae Ashm.)
	Perilampus sp.
	Cerambycobius cushmani Cwfd.
	Cerambycobius cyaniceps Ashm.
	Catolaccus near anthonomi.
	Catolaccus hunteri Cwfd.
	Catolaccus incertus Ashm.
	Sigalphus curculionis Fitch.
	Urosigalphus anthonomi Cwfd.
	Urosigalphus schwarzi Cwfd.
	Bracon mellitor Say.
*Anthonomus heterothecae Pierce	Eurytoma tylodermatis Ashm.
	Catolaccus hunteri Cwfd.
*Anthonomus nigrinus Boh	Catolaccus anthonomi Ashm.
	Catolaccus incertus Ashm.
	Entedon lithocolletidis Ashm.
	Eriglyptus robustus Cwfd.
	?Phanerotoma tibialis Hald.
*Anthonomus signatus Say	Catolaccus anthonomi Ashm.
	Catolaccus hunteri Cwfd.
	Catolaccus incertus Ashm.
	Calyptus tibiator Cr.
	Bracon anthonomi Ashm.
Anthonomus scutellatus Gyll	Sigalphus canadensis Prov.
*Anthonomus squamosus Lec	Eurytoma tylodermatis Ashm.
	Catolaccus hunteri Cwfd.
	Bracon mellitor Say.
*Anthribus alternatus Say	Microdontomerus anthonomi Cwfd.
*Apion decoloratum Sm	Catolaccus incertus Ashm.
*Apion griseum Sm	Catolaccus incertus Ashm.
*Apion rostrum Say	Cerambycobius cyaniceps Ashm.
*Apion segnipes Say	Eurytoma tylodermatis Ashm.
*Araecerus fasciculatus Woll	Cerambycobius cushmani Cwfd.
Attelabus rhois Boh	Omphale elongatus Ashm.

*Auleutes tenuipes Lec.	Eutrichosoma albipes Cwfd.
	Catolaccus incertus Ashm.
Balaninus sp.	Urosigalphus armatus Ashm.
*Balaninus nasicus Say.	Myiophasia aenea Wied.
	?Trichacis rufipes Ashm.
(Brachytarsus Sch. 1833= Anthribus Forst. 1771.)	
(Bruchus Linn. 1767= Laria Scop. 1763.)	
Calandra oryzae Linn.	Meraporus calandrae How.
	Meraporus n. sp.
	Cerocephala elegans Westw.
Ceutorhynchus rapae Gyll.	Omphale livida Ashm.
Chalcodermus aeneus Boh.	Ennyomma clistoides Towns.
	Sigalphus sp.
Chramesus icoriae Lec.	Secodes phloeotribi Ashm.
Conotrachelus sp	Urosigalphus armatus Ashm.
*Conotrachelus affinis Boh.	Myiophasia aenea Wied.
*Conotrachelus crataegi Walsh.	Cerambycobius cyaniceps Ashm.
*Conotrachelus elegans Boh.	Cholomyia inaequipes Bigot.
	Myiophasia aenea Wied.
	Sigalphus curculionis Fitch.
*Conotrachelus juglandis Lec.	Metadexia basalis G. T.
	Cholomyia inaequipes Bigot.
	Myiophasia aenea Wied.
	Sigalphus curculionis Fitch.
*Conotrachelus nenuphar Hbst.	Cholomyia inaequipes Bigot.
	Anaphes conotracheli Gir.
	Porizon conotracheli Riley.
	Sigalphus curculionis Fitch.
	Bracon mellitor Say.
Conotrachelus posticatus Boh.	Sigalphus copturi Riley.
*Craponius inaequalis Say.	Stiboscopus brooksi Ashm.
	Bracon mellitor Say.
Cryptorhynchus lapathi Linn.	Ephialtes irritator Fabr.
Cylindrocopturus longulus Lec.	Sigalphus copturi Riley.
Dendroctonus piceaperda Hopk.	Melanobracon simplex Cr.
*Desmoris scapalis Lec.	Bracon mellitor Say.
Dryocoetes autographus Ratz.	Spathius brevicaudus Ashm.
	Spathius canadensis Ashm.
Eccoptogaster muticus Say.	Helcon ligator Say.
	Spathius brunneus Ashm.
Eccoptogaster quadrispinosus Say.	Bracon scolytivorus Cr.
	Spathius trifasciatus Riley.
	Spathius unifasciatus Ashm.
	Lysitermes scolyticida Ashm.
Eccoptogaster rugulosus Ratz.	Cheiropachys colon Linn.
	Rhaphiteles maculatus Walk.
Epicaerus imbricatus Say.	Sporotrichum globuliferum S.
Hypothenemus eruditus Westw.	?Cephalonomia hyalinipennis Ashm.
Laria sp.	Horismenus sp.

Laria sp. in Lotus	Bruchophagus mexicanus Ashm.
*Laria sp. in Vachellia	Eurytoma tylodermatis Ashm.
	Cerambycobius bruchivorus Cwfd.
	Cerambycobius cushmani Cwfd.
	Cerambycobius cyaniceps Ashm.
	Urosigalphus bruchi Cwfd.
Laria alboscutellatus Horn	Bruchophagus mexicanus Ashm.
Laria amica Horn	Horismenus producta Ashm.
Laria bisignata Horn	Heterospilus sp.
Laria chinensis Linn	Pediculoides sp.
*Laria exigua Horn	Microdontomerus anthonomi Cwfd.
	Cerambycobius brevicauda Cwfd.
	Cerambycobius cyaniceps Ashm.
	Meraporus bruchivorus Ashm.
	Catolaccus incertus Ashm.
*Laria fratercula Horn	Bracon mellitor Say.
*Laria obtecta Say	Cerambycobius cyaniceps Ashm.
	Bruchobius laticollis Ashm.
Laria pisorum Linn	Bruchobius laticollis Ashm.
Laria prosopis Lec	Urosigalphus bruchi Cwfd.
Lixus concavus Say	Glyptomorpha rugator Say.
Lixus mucidus Lec	Neocatolaccus tylodermae Ashm.
*Lixus musculus Say	Eurytoma tylodermatis Ashm.
	Cerambycobius cyaniceps Ashm.
	Neocatolaccus tylodermae Ashm.
	Horismenus lixivorus Cwfd.
	Glyptomorpha novitus Cr.
	Glyptomorpha rugator Say.
Lixus parcus Lec	Neocatolaccus tylodermae Ashm.
*Lixus scrobicollis Boh	Lixophaga parva Towns.
	Eurytoma tylodermatis Ashm.
	Cerambycobius cyaniceps Ashm.
	Horismenus lixivorus Cwfd.
	Microdus simillimus Cr.
	Glyptomorpha lixi Ashm.
	Glyptomorpha mavaritus Cr.
	Glyptomorpha rugator Say.
	Vipio belfragei Cr.
Loganius ficus Schwarz	Cerocephala scolytivora Ashm.
*Macrorhoptus sphaeralciae Pierce	Eurytoma tylodermatis Ashm.
Magdalis aenescens Lec	Cheiropachys colon Linn.
	Dinotus sp.
	hyperpar. Asecodes albitarsis Ashm.
Magdalis armicollis Say	Eurytoma magdalidis Ashm.
	Rhaphiteles sp.
Magdalis olyra Hbst	Spathius canadensis Ashm.
Mononychus vulpeculus Boh	Pimpla pterelas Say
	Pimpla inquisitor Say
*Orthoris crotchii Lec	Eurytoma tylodermatis Ashm.
	Tetrastichus sp.
	Microbracon nuperus Cr.
	hyperpar. Tetrastichus sp.

Phloeosinus dentatus Say	Spathius abdominalis Riley.
Phloeosinus graniger Chap	Spathius canadensis Ashm.
Phloeotribus frontalis Ol	Secodes phloeotribi Ashm.
	Euphorus phloeotribi Ashm.
Phytonomus punctatus Fabr	Empusa sphaerosperma.
	Entomophthora phytonomi.
Pissodes strobi Peck	Bracon pissodis Ashm.
Pityophthorus spp	Cosmophorus hopkinsii Ashm.
	Rhyssalus pityophthori Ashm.
Pityophthorus cariniceps Lec	Heterospilus pityophthori Ashm.
Pityophthorus consimilis Lec	Cerocephala pityophthori Ashm.
Pityophthorus minutissimus Zimm	Secodes phloeotribi Ashm.
Platypus compositus Say	Isaria tomicii Lugger.
Podapion gallicola Riley	Sigalphus copturi Riley.
Polygraphus rufipennis Kirby	Cosmophorus hopkinsii Ashm.
	Spathius clavipennis Ashm.
Rhodobaenus tredecim punctatus Ill.	Habrocytus rhodobaeni Ashm.
Rhyssematus lineaticollis Say	Bracon rhyssemati Ashm.
(Scolytus auct.= Eccoptogaster Hbst. 1793.)	
Smicronyx tychoides Lec	Eutrichosoma albipes Cwfd.
	Bracon smicronygis Ashm.
*Spermophagus robiniae Sch	Eurytoma tylodermatis Ashm.
	Cerambycobius cyaniceps Ashm.
	Urosigalphus bruchi Cwfd.
	Heterospilus spermophagi Ashm.
	hyperpar.? Horismenus popenoi Ashm.
*Sphenophorus parvulus Gyll	Myiophasia aenea Wied. (Phasioclista metallica Towns.)
Sphenophorus robustus Horn	Myiophasia robusta Coq.
*Tachypterellus quadrigibbus Say	Cerambycobius cyaniceps Ashm.
	Catolaccus hunteri Cwfd.
(Tachypterus Dietz 1891 preocc.= Tachypterellus Ckll. & Fall 1907.)	
Tomicus sp	Spathius canadensis Ashm.
Tomicus pini Say	Bracon strobi Ashm. ?
*Trichobaris compacta Casey	Pediculoides sp.
	Cerambycobius cyaniceps Ashm.
*Trichobaris texana Lec	Eurytoma tylodermatis Ashm.
	Cerambycobius cyaniceps Ashm.
*Trichobaris trinotata Say	Sigalphus curculionis Fitch.
Tychius semisquamosus Lec	Tanaostigmodes tychii Ashm.
*Tychius sordidus Lec	Cerambycobius cyaniceps Ashm.
*Tyloderma foveolatum Say	Eurytoma tylodermatis Ashm.
	Cerambycobius cyaniceps Ashm.
	Catolaccus incertus Ashm.
	Bracon mellitor Say.
Tyloderma fragariae Riley	Bracon analcidis Ashm.
Zygobaris xanthoxyli Pierce	Catolaccus hunteri Cwfd.
	Sigalphus zygobaridis Cwfd.

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Wickham, H. F.

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1879. Die Käfer und Hautflügler.

Bargagli, Piero,

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Howard, L. O.,

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Elliott, Ernest A., and Morley, Claude,

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THE ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO

The forty-fifth annual meeting of the Entomological Society of Ontario was held at the Ontario Agricultural College, Guelph, on November 5 and 6. The meeting was most enthusiastic and interesting, and was well attended. The late Dr. James Fletcher, the President, had for some time been working to make this the best meeting in the Society's history. His illness, which took an aggravated form just before the meeting, was the one disappointment in connection with the gathering. The Society has always counted a great deal on his genial presence and almost unfailing store of knowledge on all matters under discussion. Apart from this, however, the serious nature of his illness aroused grave apprehensions in the minds of the members.

The first afternoon was devoted almost entirely to a conference on "Some of the Chief Insect Pests of the Season." The first of these discussions was the Leaf-Blister Mite (*Eriophyes pyri*). This insect was reported from most of the fruit-growing districts of Ontario and in some localities was said to be very abundant. In discussing methods of control it was stated that though present last year in the College orchard, it had this year apparently disappeared entirely. This result was thought to be due to a spring application of lime-sulphur. Several speakers recommended the use of this wash or of kerosene emulsion, either in the fall or spring, as satisfactory remedies.

The Shot-hole Borer (*Scolytus rugulosus*) was the next pest discussed. Mr Cæsar gave an account of his observation last autumn on the ravages of this pest in cherry orchards in the Niagara district. He cited several cases where the beetles had attacked perfectly healthy cherry trees of both the sweet and sour varieties. Last year this attack began in August. This year, when in the neighborhood of St. Catherines, on June 10th, he discovered that the beetles were again very abundant and were attacking both diseased and healthy trees. The latter were already at this date thickly spotted with gum exudations and had evidently been attacked in May. Egg-laying, however, was still to some extent going on in weakened and badly diseased trees. Again this autumn the beetles have caused serious damage to both cherry and plum trees, and to a lesser extent to peach. Montmorency cherries are, however, exempt. The attack this fall began as last year in August, and continued for several weeks. The experience of the two seasons suggest: that the months of May and August are probably the times when fruit-growers in infested districts should

be on the look-out for these insects. Wherever badly infested dead or dying trees were cut down and burned last winter and the other trees thoroughly sprayed in the spring with lime-sulphur or an oil-wash, there was no damage this year until August, when swarms of beetles again appeared. The necessary breeding grounds were probably provided in the many dead trees to be found within a radius of a few miles. Dr. Felt cited cases of Scolytids having been reported migrating for several miles in large swarms. Something of this nature appears to be what has taken place in the Niagara district.

The Apple Maggot (*Rhagoletis pomonella*) occupied considerable attention. It is not, however, widespread in Ontario, and though present for several years in considerable numbers in Prince Edward County and several neighboring districts along the shore of Lake Ontario, it does not seem to have spread to any known appreciable extent during this time.

The Lesser Apple-Worm (*Enarmonia prunivora*) had been reported by several orchardists as doing much damage to their apples and a considerable amount of supposedly infested fruit had been forwarded to be examined. Only a small percentage, however, of the injuries could, with any degree of certainty, be charged against this insect. It seems, nevertheless, to be present to at least some extent in very many orchards in different parts of the province.

Another subject of much interest briefly discussed was the "Malformations of Apples and Pears due to Insects." Specimens of work of the Plum Curculio on Apples were exhibited and also of some unknown sucking insect on Snow apples from British Columbia. This injury, according to the sender of the fruit, had been warded off from his own orchard to a very large extent this year by the use of lime-sulphur, whereas the neighboring orchards where Bordeaux instead had been used were as severely attacked as last year. The cause of another class of distortion on apples and pears not uncommon in Ontario orchards was debated. Some attributed the irregular depressions and knotty appearance of such fruit to a culculio, others were just as firmly convinced that it was a sucking insect that was to blame. The discussion brought out very clearly the need of much further careful investigation of such injuries.

The Oyster-shell Scale (*Lepidosaphes ulmi*) was another topic. This is one of the worst pests in Ontario orchards. Farmers are at least aware of the need of combatting it. In addition to the common practice of using either a double application of whitewash on the trees in the fall or kerosene emulsion when the larvæ are running, a number of farmers in Ontario County claimed excellent results during the last two years from spring applications of Gillet's Lye.

Further pests briefly discussed were the Codling-moth, the Turnip and Pea Aphids, and a Leaf Hopper (*Empoasca* sp.) attacking the foliage of potatoes. Nothing of special interest in regard to the Codling-moth was reported. Its ravages this year have, as usual, been severe in unsprayed orchards and even in some sprayed orchards in the Niagara district.

The Turnip and Cabbage Aphis was reported from every part of the province, and has done unprecedented damage, especially to the turnip crop. The ordinary methods of control were recommended by some, but others believed that in a season like this no known means could keep these insects from spreading in countless numbers over turnip fields.

The Pea Aphis has done much damage, especially to late peas, whole fields of these having been destroyed. It was found that a very large number of the aphids, in some cases nearly 100%, were attacked and destroyed by a fungus disease that spread with great rapidity in some districts.

Mr. A. Gibson of Ottawa reported much damage to potatoes in the eastern part of the province from the attacks of a Leaf Hopper (*Empoasca* sp.) which seriously injured the foliage.

The chief speaker on the first evening was Dr. E. P. Felt of Albany, N. Y., who gave an illustrated lecture on "The Interpretation of Nature." The first part of the lecture was devoted to showing the work and habits of bark-boring insects. Many beautiful views made these points clear and revealed a most interesting field for insect study, and one new to most of the audience. In addition to the bark-borers many other kinds of insects of economic interest, especially to residents of towns and cities, were shown and their importance briefly pointed out. The lecture closed with an account of the House-fly as a source of danger to public health.

The morning and evening of the second day were devoted chiefly to the reading of a number of papers, mostly of a technical nature. Among those of an economic or popular character were the following:

"The Economic Importance and Food-Habits of American Cecidomyiidæ," by Dr. E. P. Felt, Albany, N. Y.; "Observations on the Sorghum Midge in Louisiana," by Mr. R. C. Treherne, Guelph; "Natural Enemies of Some Ontario Coccidæ," by Mr. A. Eastham, Guelph; "Parasite Work on the Gypsy and Brown-tail Moths in Massachusetts," by Mr. W. R. Thompson, Guelph; and "Some Beetle-haunts," by Mr. F. Morris, Port Hope.

In his paper on the Cecidomyiidæ, Dr. Felt discussed first a number of destructive genera and species, such as the Hessian Fly (*Mayetiola*

destructor), Wheat Midge (*Cecidomyia tritici*), Pear Midge (*Contarinia pyrivora*), Violet Midge (*C. violicola*), Sorghum Midge (*C. sorghicola*), Cotton Midge (*C. gossypii*), Box Elder Midge (*C. negundifolia*), and other still unnamed species attacking various plants. Attention was then called to several beneficial species, especially those of the genus *Aphidoletes,* which live on aphids. Towards the close of the paper, the interesting preferences in regard to food plants shown by Cecidomyiids were referred to. For instance, 39 species have been reared from Solidago, 28 from Salix, 16 from Aster, and 10 from Grape. The wide field for study in this great family of tiny insects was shown from the fact that there are already 700 American species known, representing 50 genera.

In his address on "Natural Enemies of Some Ontario Coccidæ," Mr. A. Eastham gave the results of a year's careful rearing and study of the chief enemies of the more common scales in the vicinity of Guelph, *viz.: Lepidosaphes ulmi, Eulecanium cerasifex, E. caryae, E. fletcheri, Pulvinaria innumerabilis,* and *Aspidiotus ostreaeformis.*

Each paper was followed by a discussion so far as time permitted.

At the evening meeting of this day, Professor W. Lockhead, of Macdonald College, St. Anne de Bellevue, Que., read a paper on "What Entomology the Farmer and Fruit-grower Should Know." He was followed by Dr. Fyles, of Levis, Que., with a popular address entitled, "The Farmer's Woodlot." Dr. Bethune then read a paper from Dr. L. O. Howard, of Washington, D. C., on "The Present Condition of the Work Connected with the Importation of Foreign Parasites of the Gypsy and Brown-tail Moth."

In this paper, Dr. Howard mentioned certain very important innovations made in the work the last year or so. These were as follows: (1) The laboratory has for greater convenience been removed to Melrose Highlands, Mass. (2) A man thoroughly equipped in the biology of his special group has been put in charge of each division of the work, so that now a Hymenopterous expert looks after the Hymenopterous parasites, a Dipterous after the Dipterous, and a Coleopterous after the Celeopterous. (3) In order that parasites shall leave Europe in a better condition to stand the ocean voyage and arrive in a good state at New York, a general laboratory depot has been established at Rennes, France, under a trained man. All shipments are looked over and properly packed by him and forwarded in the quickest and best way possible. (4) An agent has been sent to Japan, where parasites are known to keep the Gypsy Moth under complete control, and these insect allies are now arriving in large numbers. Not a few of them have already been colonized.

(5) Active winter work with parasites is being carried on. The parasites are secured from nests of Brown-tail Moths from Europe. These are bred in artificially heated rooms and fed upon native hibernating Brown-tail larvæ, the latter being fed upon vegetables obtained chiefly from greenhouses. (6) The eggs of Brown-tail Moths are being retarded in development by keeping them in cold storage until the arrival of egg-parasites from abroad. These readily oviposit and breed in such eggs. This and the preceding innovation permit of numerous generations of parasites being produced at times of the year otherwise impossible. The important predatory European beetle, *Calosoma sycophanta*, has been successfully reared and has established itself. Over 200,000 of the most active enemies of the Gypsy and Brown-tail Moths have been liberated this year under most favorable circumstances. At least 7 of the 57 species introduced are already known to have established themselves. Many others will, it is believed, soon be found to have done likewise. Dr. Howard considers the outlook more favorable than ever, and ultimate success certain.

The paper was greatly appreciated, and a vote of thanks to Dr. Howard, coupled with a statement of the Society's deep interest in and appreciation of this great work, was unanimously carried. A vote of thanks to Dr. Felt was also passed for his kindness in coming so far to attend the meeting and for the great assistance given by him in helping to throw light on the many difficult problems that arose during the discussions.

The evening meeting was concluded by a short account by Dr. Bethune of "The Insects in Ontario that had Attracted Notice During the Past Season."

L. Caesar, *Ex-Secretary.*

JOURNAL OF ECONOMIC ENTOMOLOGY PUBLISHING CO.

The annual meeting of the stockholders of this company will probably be held Monday evening, December 28th, the precise time and place being announced at one or more sessions of the Association of Economic Entomologists. Members of the Advisory Board are hereby notified that it devolves upon them to nominate the elective officers.

E. P. Felt, *President.*
E. Dwight Sanderson, *Secretary.*

TWENTY-FIRST ANNUAL MEETING ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Baltimore, Md., December 28, 1908

The twenty-first annual meeting of the Association of Economic Entomologists will be held in Baltimore, Md., on Monday and Tuesday, December 28 and 29, 1908. The sessions will open at 10 a. m. Monday at the Eastern High School, corner of Broadway and North Avenue. The afternoon session will begin at 1 p. m. and meetings will be held on the following day at the same hours. Arrangements will be made to hold a session Monday evening if it is necessary to do so in order to transact all the business.

Other Meetings

The American Association for the Advancement of Science and its affiliated societies will hold meetings throughout the week.

The American Association of Horticultural Inspectors will hold sessions at 8 p. m. Tuesday, Dec. 29, and at 9 a. m. Wednesday, Dec. 30.

The Entomological Society of America will meet Wednesday and Thursday, Dec. 30 and 31.

Railroad Rates

A railroad rate of one fare and three-fifths for the round trip, on the certificate plan, has been granted by the Trunk Line Association, the New England Passenger Association (excepting via N. Y., Ont. and W. Ry., the Eastern Steamship Company and the Bangor and Aroostook R. R.), the Eastern Canadian Passenger Association, and the Central Passenger Association.

The Western Association has on sale revised one-way fares in effect to Chicago, Peoria and St. Louis, with the understanding that persons can repurchase from these points and take advantage of any reduced fares that may be authorized therefrom. The fares to Chicago, Peoria and St. Louis from a large part of the Western Passenger Association territory are now on the basis of two cents per mile; hence, with the reduced fares from the three cities named, the net rate amounts practically to a rate of fare and three-fifths for the round trip. A rate of fare and three-fifths has also been requested from the Southern and the Trans-Continental Passenger Associations, but decisions have not yet been received.

The following directions are submitted for your guidance:

1. Tickets at full fare for the *going* journey may be secured within three days prior to, and during the first three days of the meeting. The advertised dates of the meeting are December 26, 1908, to January 2, 1909, consequently, you can obtain your tickets not earlier than December 23, 1908, and not later than December 28, 1908.

From points located at a great distance, from which it takes more than

three days to reach Baltimore, going tickets may be purchased on a date which will permit members to reach Baltimore by December 26, 1908.

2. Present yourself at the railroad station for ticket and certificate at least thirty minutes before departure of the train.

3. Certificates are not kept at all stations. If you inquire at your station you will find out whether certificates and through tickets can be obtained to the place of meeting. If not obtainable at your home station, the agent will inform you at what station they can be obtained. You can in such case purchase a local ticket thence, and there purchase through ticket and secure certificate to place of meeting. Be sure that, when purchasing your going ticket, you request a *certificate. Do not make the mistake of asking for a receipt.*

4. On your arrival at the meeting, present your certificate to Mr. F. S. Hazard, assistant secretary. It has been arranged that the special agent of the Trunk Line Association will be in attendance at the office of the Permanent Secretary, to validate certificates daily (9 a. m. to 6 p. m.) from Tuesday, December 29, 1908, to Saturday, January 2, 1909, both dates inclusive. *A fee of 25 cents will be charged at the meeting for each certificate validated.* If you arrive at the meeting and leave for home prior to the special agent's arrival or if you arrive at the meeting later than January 2 after the special agent has left, you cannot have your certificate validated and consequently you will not get the benefit of the reduction on the home journey. *No refund of fare will be made on account of failure to have certificate validated.*

If the necessary minimum is in attendance, and your certificate is duly validated, you will be entitled, up to and including January 6, 1909, to a continuous passage ticket to your destination via the route over which you made the going journey, at three-fifths of the limited fare.

Hotel Headquarters

The hotel headquarters of this Association and of the Association of Horticultural Inspectors will be at the Rennert Hotel, Saratoga and Liberty streets, where a rate of $1.50 a day and upwards, on the European plan, has been secured.

Special

The meeting at Baltimore will be the twenty-first annual meeting of this Association. A large number of members have signified their intention of being present and an excellent program is assured.

All members or other persons interested in entomology are urged to attend and to assist in making this the largest and most successful meeting in the history of the Association.

Program

Monday, December 28, 1908, 10 a. m.

Annual address of the President, by Dr. S. A. Forbes, Urbana, Ill.

Report of the Secretary.

Report of the Committee on Constitution, by J. B. Smith, New Brunswick, N. J.

Report of the Committee on National Control of Introduced Insect Pests, by Wilmon Newell, Baton Rouge, La.

Report of the Committee on Nomenclature, by Herbert Osborn, Columbus, Ohio.

Report of the Committee on Testing Proprietary Insecticides, by E. D. Sanderson, Durham, N. H.

Report of the committee appointed to attend the Annual Meeting of the American Association of Nurserymen, by T. B. Symons.

Report of the committee appointed to attend the Annual Meeting of the Society for the Promotion of Agricultural Science, by A. F. Burgess, Washington, D. C.

Miscellaneous Business.

Appointment of Committees.

Reading of Papers

"Biological Notes on Murgantia histrionica," by R. I. Smith, Raleigh, N. C.

Statement of observations and experiments made during 1908, with particular reference to egg-laying and number of broods and their relation to remedial measures. 15 minutes.

"Pemphigus tessellata Fitch." By Edith M. Patch, Orono, Me.

Items in regard to the life history heretofore unrecorded, including notes on migrants, true sexes and eggs. 10 minutes.

Adjournment.

Program

Monday, December 28, 1 p. m.

Discussion of the Presidential Address.

Reading of Papers

"The Economic Status of the House Fly." By E. P. Felt, Albany, N. Y.

A discussion of the economic importance of this insect. 15 minutes.

"Notes on Cranberry Pests." By H. J. Franklin, St. Anthony Park, Minn.

Notes on life histories of some of the insects concerned and some general observations on parasitism. 15 minutes.

"Means Whereby the Economic Entomologist Can Advance Apiculture." By E. F. Phillips, Washington, D. C. 15 minutes.

"A Method of Securing Apicultural Statistics." By Burton N. Gates, Washington, D. C.

Description of a method which has been successfully tried in Massachusetts. 10 minutes.

"Notes on Empoasca mali LeB." By F. L. Washburn, St. Anthony Park, Minn.

New facts concerning the life history of this insect. 15 minutes.

"Do We Need the Insectary?"

General Discussion, which will be opened by E. D. Sanderson, Durham, N. H.

"Relating to Parasites." By L. O. Howard, Washington, D. C.

Adjournment.

Program

Tuesday, December 29, 10 a. m.

Reading of Papers

"The Identity and Synonymy of a Few of Our Common Soft Scales (Coccidae)." By J. G. Sanders, Washington, D. C. 12 minutes.

"Notes on Photomicrography and Insect Photography." By J. G. Sanders, Washington, D. C. 5 minutes.

"Photomicrography of the Diaspinae." By R. A. Cooley, Bozeman, Mont.

Advantage of photographs over drawings; preparing the microscopical slides; camera lenses and illumination; plates, developer and exposure; prints. 15 minutes.

"The Importance of Proper Methods in Entomological Investigation." By F. M. Webster, Washington, D. C. 15 minutes.

"Additional Experiments with the Corn Field Ant (Lasius niger americanus)." By S. A. Forbes, Urbana, Ill. 15 minutes.

"Fumigation Dosage for Tomatoes and Cucumbers." By H. T. Fernald, Amherst, Mass.

Factors influencing the resistance of these plants to fumigation and the strength of gas under which satisfactory results can be obtained at different ages. 15 minutes.

"Experiments in the Control of the Codling Moth." By E. D. Sanderson, Durham, N. H.

A discussion of the recent experimental work in spraying for the codling moth. 15 minutes.

Adjournment.

Program

Tuesday, December 29, 1 p. m.

Reading of Papers

"Tree Crickets and Injury to Apple Wood." By P. J. Parrott, Geneva, N. Y. 15 minutes.

"The Distribution of San Jose Scale in Iowa." By H. E. Summers, Ames, Iowa.

Notes on localities and amount of injury at northern limit of scale in this region. 5 minutes.

"The Self Boiled Lime-Sulphur Wash as a Summer Treatment for the San Jose Scale." By A. L. Quaintance, Washington, D. C. 15 minutes.

"Summary of Results of Fumigation and Dipping Experiments." By T. B. Symons, College Park, Md. 10 minutes.

"Does Arsenical Spraying Injure Apple Trees?" By E. D. Ball, Logan, Utah.

A review of Bulletin 131, Colorado Agricultural Experiment Station, with further evidence on the matter. 15 minutes.

"An Experiment in the Control of Curculio on Peach." By E. P. Taylor, Mountain Grove, Mo.

Results of a remarkably successful experiment conducted in the Ozark peach belt in the control of *Conotrachelus nenuphar* Hbst. on peach by using a reduced formula of lead arsenate. 12 minutes.

"Notes of the Year from North Carolina." By Franklin Sherman, Jr., Raleigh, N. C. 10 minutes.

"Entomological Notes from Georgia." By E. L. Worsham, Atlanta, Ga. 10 minutes.

"Insects of the Year in Iowa." By R. L. Webster, Ames, Iowa. 10 minutes.

Reports of Committees.

Miscellaneous Business.

Election of Officers.

Final Adjournment.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

DECEMBER, 1908

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints of contributions may be obtained at cost. Minor line figures will be reproduced without charge, but the engraving of larger illustrations must be borne by contributors or the electrotypes supplied. The receipt of all papers will be acknowledged.—EDS.

The successful completion of the first volume of the JOURNAL has been rendered possible only by the hearty co-operation on the part of all. The Business Manager and the Advertising Manager have both been obliged to put a large amount of time and energy into the enterprise. The hearty co-operation of all contributors and the readiness with which a number complied with requests, have materially lightened the burden of the editors. The JOURNAL, judging from the matter already published, has proved a most useful medium for the presentation of matter of great interest and importance to the practical or economic entomologist, though perhaps of only secondary value to the general public. The latter is true only because technical matters relating to biology and identity, while absolutely necessary to the establishment of correct methods of control, possess little significance to a man simply interested in protecting a crop. Furthermore, this serial affords a ready medium for the frank discussion and free criticism of results. This latter, so long as the ordinary rules of courtesy are observed, cannot but react in a most beneficial manner. This enterprise has also made possible the prompt publication of the Proceedings of the annual meeting. This in turn should lead to a desirable modification in at least certain of the papers, and result in the presentation at the meetings of a synopsis of extended contributions rather than the submission of numerous details requiring careful study and consideration prior to intelligent discussion. We trust that there will be more time than heretofore for the presentation of methods and principles, leaving the numerous details to be recorded in the published proceedings.

Obituary

DR. JAMES FLETCHER

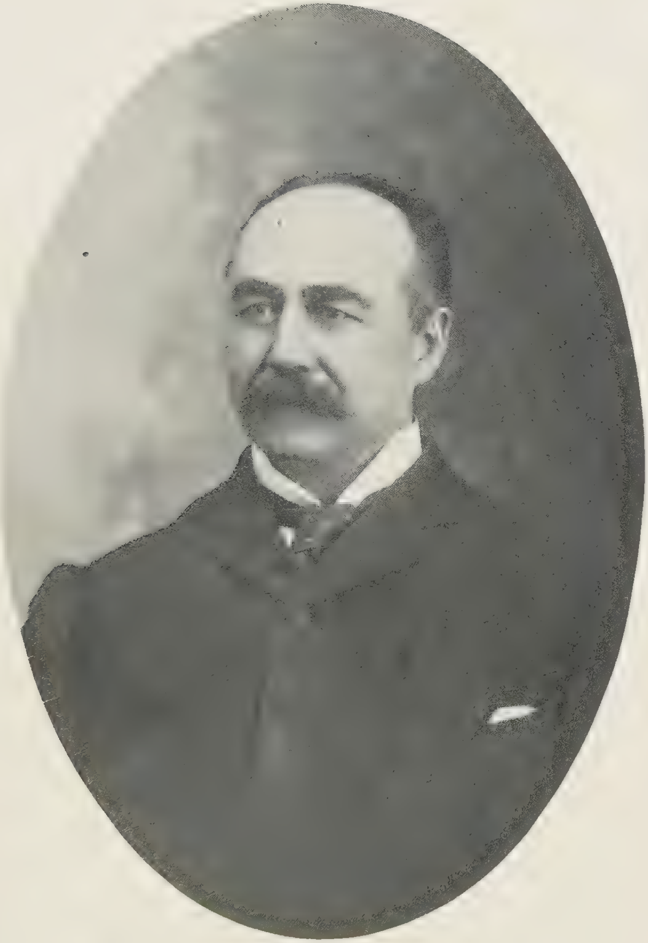
The death of Dr. James Fletcher comes as a sense of personal loss to all who ever met him, and of the older American entomologists there are few that have not met him. And no one who ever came into any close contact with James Fletcher failed in deriving some benefit from that contact. Big in body and mind, he abhorred littleness of all sorts and would believe ill of no one until the evidence was overwhelming. Thoroughly good-natured himself under all conditions, he brightened up all about him, and no meeting was dull where he had part in it. Practical in all things and impatient of indirection and complications, a few pertinent words from him would often straighten out a tangle and bring agreement where disagreement seemed inevitable.

Dr. Fletcher began his work in entomology as did so many of the generation now largely passed away, by field observations—as a collector in fact. The writer made his acquaintance by correspondence nearly twenty-five years ago, while he was yet in the Library of Parliament at Ottawa, and when, later we met personally at one of the meetings of the Entomological Club of the A. A. A. S., a friendship was formed that lasted so long as both lived.

But Dr. Fletcher was not an entomologist only—he was quite as much of a botanist and knew plants perhaps even better than he did insects; while few birds and other animals of his country were unfamiliar to him. He loved nature in all its aspects and his observations in the field were accurate and reliable.

A characteristic feature in his make-up was his ability to inspire enthusiasm and to carry conviction. People believed him and in him, and he justified their faith. No one less able than he could have accomplished in Canada the work that he did, and the extent of that work can scarcely be appreciated by any one who has not followed it step by step. In 1887 he became officially what he had been practically for some time before, Entomologist and Botanist to the Dominion, and his territory extended from Nova Scotia to Vancouver, with all the problems that such a range opened up.

And while demands upon him increased as the Experimental Farm developed, assistance was given slowly until he carried a burden that can never again be imposed upon any one man. Fletcher was never a systematist and his works are largely in his official reports and in the publications of the Entomological Society of Ontario. Conservative always, he was never backward in adopting approved practice.



James Fletcher

He made haste slowly and feared only to do that which might weaken the faith of his constituency in his honesty and the effectiveness of the practice recommended. His idea was to prove all things first and, so far as possible, recommend only from personal experience. The justification of his course so far as his constituency is concerned is the universal respect and regard in which he was held from Atlantic to Pacific. He encouraged collectors and students always and everywhere to the full extent of his ability; he assisted in founding such organizations as the Ottawa Field Naturalist's Club, and served as an officer in associations of all kinds. He was for a time Secretary and Treasurer of the Royal Society of Canada, and in the Entomological Societies in the United States he has presided over the Association of Economic Entomologists and the Entomological Society of America.

It is the function of others more closely associated with him to give biographical details and lists of papers: the present is a tribute to the man and his work.

Dr. Fletcher was born March 28, 1852, at Kent in England, and died November 8th, at Montreal, Canada, leaving a widow and two daughters.

J. B. Smith.

WILLIAM HARRIS ASHMEAD

We regret to note the decease of Dr. Wm. H. Ashmead at St. Elizabeth's Hospital, Washington, D. C., on October 17. Dr. Ashmead in his earlier days was deeply interested in economic entomology, while his labors of recent years have given him a commanding position among Hymenopterists. His numerous determinations have been of greatest value to all economic workers. The general esteem in which he was held is admirably expressed in the following resolutions:

Whereas, The Entomological Society of Washington has lost by death its former president, William Harris Ashmead; and

Whereas, Doctor Ashmead was one of the oldest members of the Society and had, by his extraordinary activity and genius in entomological investigations, especially of a systematic character, contributed very greatly to the interest of the meetings of the Society and to the importance of its publications; and

Whereas, His warm-hearted enthusiasm and his kindly, helpful character had brought him to occupy a high place in the affections of all of the members of the Society; therefore, be it

Resolved, That in the death of Doctor Ashmead the Society has suffered a very great loss; that the field of systematic entomology has been deprived of one of its most prominent workers, and that the

development of that branch of science not only in this country but throughout the world will be retarded by his untimely end; and be it further

Resolved, That the members of the Society who loved and admired him will always profit by the memory of his indefatigable energy and his untiring effort to bring order out of the chaos of described and undescribed forms; be it further

Resolved, That a committee be appointed to prepare a sketch of Doctor Ashmead's life (including bibliography) for publication in the Proceedings of this Society, and that copies of these resolutions be sent, with an expression of sincere sympathy, to his family.

L. O. Howard.
E. A. Schwarz.
N. Banks.

Washington, D. C., October 19, 1908.

ALEXANDER CRAW[1]

With the death of this remarkable man passes away another prominent figure from the horizon of American horticulture and economic entomology. Few economic entomologists are better known and no one more favorably than was he during his life work. Few entomological workers passed through California without seeking out and making his personal acquaintance, and all were charmed with the man. His unvarying amiability has won for him a lasting abode in the heart of every one that knew him. By early training a capable and successful horticulturist, his indomitable love for plant life later led him to form the vanguard of a fight against horticultural enemies on a scale that was never undertaken before.

Alexander Craw was born in Ayr, Scotland, August 3, 1850. In 1873 he emigrated to California and after a two years' residence in San Diego, moved to Los Angeles, where he took charge of the famous Wolfskill orange grove. His early training stood him in good stead in the early days of California's growth as a horticultural center. His authority in matters horticultural was never questioned and his advice ever eagerly sought. Presently *Icerya purchasi*, which had preceded his arrival in California by about five years, threatened the destruction of the citrus industry. It is difficult to determine at present who started the movement which culminated in the introduction of *Novius cardinalis* from Australia into California by Albert Koebele in 1888. But it is certain that Mr. Craw was a powerful factor in that movement. Never in our conversation in the office did he credit himself with the conspicuous rôle, yet it is quite evident to me that his constant agitation of the matter before the California horticultural

[1]Haw. Ent. Soc. Proc. 2:24–26, 1908.

organizations, and the incessant pressure he brought to bear by means of these upon authorities in Washington was to a considerable degree responsible for Koebele's victorious mission. Once victory was achieved and that so completely and in such an unusual manner he was possessed with the idea of controlling all horticultural insect pests by means of their natural enemies.

About 1890 he was prevailed upon to accept the office of inspector and entomologist under the California State Board of Horticulture, a line of work not previously undertaken anywhere and in which he spent the remainder of his life. Always kindly, yet always firm in the performance of his duty, he stood for fourteen years like a rock at the Golden Gate and jealously guarded his adopted state from horticultural pests of the world. All opposition he swept aside with a smile, without making a foe or losing a friend. He was a keen observer, so that by 1891 we find him not only familiar with the common garden and orchard pests but describing a species of his favorite group, Hymenoptera Parasitica (*Coccophagus* [=*Aspidiotiphagus*] *citrinus*, Bull. 57, California State Board of Horticulture, 1891). His writings are not profuse, and are confined almost entirely to periodical reports, in which he aimed principally to enlighten his horticultural readers on their insect problems as he viewed them. In Bull. 4, Tech. Ser., Division of Entomology, U. S. D. A., he published a list of the Coccidæ which he found in course of inspection at San Francisco. A number of species and varieties named *Crawii* may be observed in catalogues of this family.

In 1904 he was induced to enter the service of the Hawaiian Board of Agriculture as Superintendent of Entomology and Inspector. This office he filled in the same efficient manner that he had carried on the work in California, proving of great benefit to Hawaii in the exclusion of dangerous insect pests, and resulting in a better quality of fruits and vegetables being shipped here. His devotion to duty had the better of discretion, so that when on October 11, 1907, he was overtaken by the serious illness which on June 28, 1908, terminated his life, it was largely the result of overwork.

JACOB KOTINSKY.

FRANCIS HUNTINGTON SNOW

We regret to record the death on September 28, of Dr. F. H. Snow, for many years head of the Department of Entomology and Chancellor of the University of Kansas from 1889 to 1901. A more fitting notice of Dr. Snow and his work will appear in a subsequent issue.

Reviews

Arsenical Poisoning of Fruit Trees, by WILLIAM T. HEADDEN, Colorado Agricultural Experiment Station, Bulletin 131, 1908, p. 1–28.

This bulletin is of particular interest to entomologists, since the writer submits evidence showing that under certain conditions at least, repeated applications of arsenical poisons may result in serious injury to the trunks and roots of fruit trees. It is probable that the injuries from arsenical applications recorded by the author have been caused, in large measure, by the alkaline elements of Colorado soils reacting upon the arsenical compounds and producing combinations deleterious to the welfare of the trees; nevertheless the subject is one of much importance to all economic entomologists and there should be a careful watch for the appearance of any such trouble in other sections of the United States.

The Catalpa Midge, by H. A. GOSSARD, Ohio Agricultural Experiment Station, Bulletin 197, 1908, p. 1–12.

The life history and work of *Cecidomyia catalpae* Comst. is discussed in detail. The author recommends cultivation, fertilization and close planting in order to overcome in a large measure injuries by this midge. He provisionally advises the application of kainit in May and June for the destruction of the larvæ in the soil. The value of this bulletin is greatly increased by an excellent series of original illustrations.

The California Grape Root Worm, by H. J. QUAYLE, California Agricultural Experiment Station, Bulletin 195, 1908, p. 1–26.

This is a detailed account of the European *Adoxus obscurus* Linn., a species working in a very similar manner to the eastern grape root worm, *Fidia viticida* Walsh. The life history and habits of this insect are given in detail and the value of the publication is much enhanced by a fine series of original illustrations. Remedial measures advised by the author are deep cultivation for the destruction of pupæ, the application of a strong arsenical spray for destroying the beetles or the employment of a beetle catcher.

The Grape Leaf Hopper, by H. J. QUAYLE, California Agricultural Experiment Station, Bulletin 198, 1908, p. 177–216.

This is an extended biologic and economic discussion of *Typhlocyba comes* Say, illustrated by an excellent series of original figures. The author concludes that the most satisfactory method of controlling this species is by the use of a screen cage, a wire covered device especially adapted for the capture of leaf hoppers.

Fumigation for the Citrus White Fly as Adapted to Florida Conditions, by A. W. MORRILL, U. S. Department of Agriculture, Bur. Ent. Bulletin 76, p. 1–73.

This bulletin gives the results obtained from two winters of experimentation on the white fly in Florida. There is an extended discussion of the conditions and chemicals necessary to obtain good results. The description of the equipment and its method of operation is exceedingly helpful. The large amount of

data condensed in a series of tables affords an excellent basis for estimating the dosage. The work of the past two years has demonstrated the practicability of solving this big insect problem of Florida and other citrus districts on the Gulf coast. The practical value of the bulletin is greatly increased by the excellent series of original illustrations. It can not but prove of great service to citrus growers. The author is to be congratulated upon having covered the subject in such a comprehensive manner.

A Few Orchard Plant Lice, by C. P. Gillette and E. P. Taylor, Colorado Agricultural Experiment Station, Bulletin 103, 1908, p. 1–48.

This bulletin gives in concise form the results of extended observations and experimentation upon a number of the more injurious plant lice occurring in orchards. Two well executed colored plates constitute an extremely valuable addition to this publication. The life history notes and the results secured with various insecticides will be especially valuable to the entomologist. An abbreviated edition of this publication without the colored plates has been issued by the station as Bulletin 134.

The European Elm Scale, by Samuel B. Doten, Nevada Agricultural Experiment Station, Bulletin 65, 1908, p. 1–34.

This bulletin gives a detailed biological account of *Gossyparia spuria* Mod. based on original observations. Its value is greatly enhanced by excellent reproductions from an extensive series of enlarged photographs and numerous drawings showing structural details. Experiments with lime-sulphur wash, kerosene emulsion and scalecide are discussed, the last named apparently giving the best results, though the author inclines strongly to recommend thorough spraying with a forcible jet of water just before the leaves begin to show and again in June before the young scale insects appear. This bulletin is an important contribution to our knowledge of this pest.

A Contribution to Our Knowledge of Insecticides, by C. T. McClintock, E. M. Houghton and H. C. Hamilton. A Reprint from the Michigan Academy Sci. 10th Report, 1908, p. 197–208.

This paper records the results obtained in a very suggestive attempt to standardize the insecticidal properties of a number of contact insecticides and to show the relationship existing between insecticidal, germicidal and toxical values. The authors conclude that there is not any close connection between the three and urge the importance of establishing standard tests for the accurate comparison of insecticides. They found in their work that the common bedbug was a most satisfactory insect for making comparative tests. They state that chemical standardization of contact insecticides is at present impossible, since two substances having essentially the same chemical composition may vary enormously in their insecticidal values. It is to be hoped that this paper will stimulate other investigations along similar lines.

Fungous Diseases of Scale Insects and White Fly, by P. H. Rolfs and H. S. Fawcett, Florida Agricultural Experiment Station, Bulletin 94, 1908, p. 1–17.

Climatic conditions in Florida are unusually favorable for the development of fungous diseases. The authors have in this bulletin given brief popular

accounts of several beneficial fungi living at the expense of scale insects and white fly. This bulletin contains an excellent series of original illustrations.

Hawaiian Honeys, by D. L. VanDine and Alice R. Thompson, Hawaii Agricultural Experiment Station Bulletin 17, 1908, p. 1–21.

This is a study of the physical and chemical composition of Hawaiian honeys in an effort to establish some standards for comparison with honeys from other parts of the world.

Dipping of Nursery Stock in the Lime-Sulfur Wash, by P. J. Parrott, H. E. Hodgkiss, W. J. Schoene, New York Agricultural Experiment Station Bulletin 302, 1908, p. 175–202.

The results of a series of experiments are given in some detail. the authors concluding that the dipping of nursery stock in the standard lime-sulphur wash for the purpose of destroying San José scale is of doubtful value. They advise the fumigation of trees with hydrocyanic acid gas.

Some Destructive Shade Tree Insects, by F. L. Washburn, Minnesota Agricultural Experiment Station Press Bulletin 33, p. 1–32.

This bulletin gives summarized, practical discussions of a number of the more injurious insects affecting shade trees, remedial measures receiving special attention. The bulletin is printed on an excellent grade of paper and the large series of original illustrations come out in a most gratifying manner.

Insects and Diseases of Vegetables, by Melville Thurston Cook and William Titus Horne, Estacion Central Agronomica de Cuba, Bulletin 12, 1908, p. 3–28.

Brief illustrated accounts of a number of injurious insects and fungous diseases affecting various crops. The value of this bulletin is greatly increased by a number of process illustrations, some of which are susceptible of considerable improvement.

Injurious Insects, by Fabian Garcia, New Mexico Agricultural Experiment Station Bulletin 68, 1908, p. 1–63.

This bulletin notices a large number of the more injurious insects and is designed in particular to meet the needs of gardeners, fruit growers and farmers. It is illustrated by numerous cuts, most of them being reproductions from various entomological publications.

Some Insect Enemies of Garden Crops, by R. I. Smith, North Carolina Agricultural Experiment Station, Bulletin 197, 1908, p. 1–64.

This bulletin consists of brief economic illustrated accounts of a large number of injurious insects, being especially adapted for the use of gardeners.

Caterpillars Injuring Apple Foliage in Late Summer, by E. Dwight Sanderson, New Hampshire Agricultural Experiment Station, Bulletin 139, 1908, p. 207–228.

This bulletin consists of a series of popular economic accounts of a number of the more injurious leaf feeders occurring in late summer. It is admirably illustrated by a series of mostly original figures.

Current Notes

Conducted by the Associate Editor

Professor JOHN BERNARD SMITH, state entomologist of New Jersey, passed his fiftieth birthday November 21. A fortnight prior he confided to a friend that he proposed to celebrate the event by calling a special meeting of the Brooklyn Entomological Society, of which he has always been an active member, and entertaining them at dinner, a surprise party. The news leaking out, action was taken by the three societies of the Metropolitan district, Brooklyn, New York and Newark. A joint committee arranged a surprise for Professor Smith at a dinner given in his honor at the Imperial Hotel, Brooklyn, on the evening of his birthday.

Fifty entomologists assembled. Charles W. Leng, president of the New York Entomological Society, acted as chairman of the meeting. R. F. Pearsall, president of the Brooklyn Entomological Society, and H. Wormspacher, president of the Newark Entomological Society, assisted. E. L. Graef, the veteran Brooklyn lepidopterist, acted as toastmaster. A silver loving cup, the gift of individual members of the three societies, was presented with fitting remarks by C. H. Roberts, the authority on aquatic Coleoptera, who, with Professor Smith, is a charter member of the Brooklyn Society. A stein, capacious enough for a draught by all those present, was sent by Dr. R. Ottolengui, the monographer of Piusia.

Among those present were Dr. Henry Skinner and Mr. Daacke of the Feldman Social, Philadelphia; Prof. R. C. Osburn of Columbia University; F. A. Lucas, chief of the museum of the Brooklyn Institute of Arts and Sciences; Wm. Beutenmuller and Mr. Muehler of the American Museum of Natural History; E. B. Southwick, entomologist of Central Park; Edward Moore, Brooklyn city entomologist; L. A. Best, president of the department of entomology of the Brooklyn Institute; G. P. Engelhardt, curator of the Brooklyn Children's Museum; Rev. J. L. Zabriskie, Geo. Franck, Jacob Doll, lepidopterist of the Brooklyn Museum, and J. J. Levison, forester of Prospect Park. The New Jersey Agricultural Experiment Station was represented by J. A. Grossbeck, E. L. Dickerson and H. H. Braehme.

Letters of congratulation came from Dr. L. O. Howard, Washington; Dr. E. P. Felt, Albany; Prof. W. M. Wheeler, Harvard University; Karl Fuchs, San Francisco; Prof. J. H. Comstock, Cornell University; Dr. William Barnes, Illinois, and many others.

The occasion was most pleasurable to all and Professor Smith was forced to admit that the testimony of his loving friends almost compensated for the crossing of the fiftieth year mark.

A. H. Kirkland, Superintendent for Suppressing the Gypsy and Brown Tail Moths, has, we learn through the press, resigned his position on account of ill health. Mr. Kirkland has been a most conscientious official and we feel that his resignation means a serious loss to the Commonwealth of Massachusetts, since it will be very difficult to fill the position he has made vacant.

Prof. Glen W. Herrick has resigned the office of State Entomologist of Mississippi and accepted the position of State Entomologist of Texas. Address, College Station, Texas.

Mr. R. W. Harned, who was Assistant Entomologist under Prof. Herrick, has been placed in charge of the entomological work in Mississippi.

Prof. C. E. Chambliss has resigned as State Entomologist of South Carolina and has accepted a position with the Bureau of Plant Industry, United States Department of Agriculture. He will have charge of rice investigations. Address, Washington, D. C.

Dr. E. V. Wilcox, who had charge of preparing data on entomological publications for the Experiment Station Record, has been appointed Director of the Hawaiian Agricultural Experiment Station at Honolulu, Hawaii. He is now in charge of the work there.

Mr. W. A. Hooker of the Bureau of Entomology is now in charge of the work formerly carried on by Dr. Wilcox for the Office of Experiment Stations. Address, Washington, D. C.

Prof. C. F. Adams, Professor of Entomology at the University of Arkansas, has, in addition to his present duties, been made Acting Director of the Agricultural Experiment Station and Acting Dean of the College of Agriculture of that institution, vice Prof. W. G. Vincenheller, resigned.

Mr. H. L. Viereck has accepted a position as Entomologist for the Parke, Davis Company, Detroit, Mich.

Mr. Jacob Kotinsky has been appointed Superintendent of Entomology by the Board of Commissioners of Agriculture and Forestry of Hawaii. The position was made vacant by the death of Alexander Craw.

Mr. D. H. Kuhns has been appointed assistant inspector under Mr. Kotinsky.

Mr. George G. Ainslee, a graduate of the University of Minnesota, and Mr. T. D. Urbahns, a graduate of the Colorado Agricultural College, are now employed by the Bureau of Entomology as Special Field Agents and are working on insects which affect cereal and forage crops.

Mr. J. B. Garret, Associate Entomologist of the Louisiana Agricultural Experiment Station at Baton Rouge, has been appointed Assistant Director of the North Louisiana Agricultural Experiment Station, Calhoun, La.

Prof. Carlos E. Porter, editor *Revista Chilena de Historia Natural*, Casilla 2352, Santiago, Chili, has recently written Dr. L. O. Howard that he is anxious to secure papers published in the last twelve or fifteen years on Acari, Longicorns, Centipedes, Hemiptera, Algæ, Fungi and Crustacea. He also states that specialists who may desire to study the collections in the newly formed Museum of Valparaiso will be allowed to do so under the following conditions: (a) Specialist to retain duplicates; (b) Specialist to return one male and one female determined; (c) Specialist to send typewritten diagnosis of new species for publication in the *Revista*. One hundred separates of each article will be furnished.

An examination made by Mr. J. C. Crawford of the United States National Museum of the work of the late Dr. W. H. Ashmead brings out the fact that he has described over 500 new genera and over 3,100 new species of insects.

Mailed December 15, 1908.

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